A Prospective Study of

FUNCTIONAL OUTCOME AND ROTATIONAL ALIGNMENT OF FEMORAL COMPONENT IN UNNAVIGATED TOTAL KNEE ARTHROPLASTY

Dissertation submitted to

THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY

CHENNAI – 600 032

In partial fulfillment of the regulations for the award of the

M.S. DEGREE BRANCH - II

ORTHOPAEDIC SURGERY

GOVERNMENT MOHAN KUMARAMANGALAM

MEDICAL COLLEGE, SALEM

APRIL 2014

CERTIFICATE

This is to certify that **Dr. SENTHIL P**, Postgraduate student (2011-2014) in the department of Orthopaedics, Government Mohan Kumaramangalam Medical College, Salem has done this dissertation ***"A Prospective Study of* FUNCTIONAL OUTCOME AND ROTATIONAL ALIGNMENT OF FEMORAL COMPONENT IN UNNAVIGATED TOTAL KNEE ARTHROPLASTY"** under my supervision in partial fulfillment of the regulation laid down by the Tamilnadu Dr. M.G.R Medical University, Chennai for M.S. (Orthopaedics) degree examination to be held during April 2014.

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DECLARATION

I, **Dr. SENTHIL P**, solemnly declare that this dissertation titled **"FUNCTIONAL OUTCOME AND ROTATIONAL ALIGNMENT OF FEMORAL COMPONENT IN UNNAVIGATED TOTAL KNEE ARTHROPLASTY"** is a bonafide work done by me, at Government Mohan Kumaramangalam Medical College, Salem between the period 2011-2013, under the guidance of my unit Chief **Prof. Dr. T.M.MANOHAR M.S. (Ortho),** Professor of Orthopaedic Surgery. This dissertation is submitted to Tamilnadu Dr. M.G.R Medical University, towards partial fulfillment of regulation for the award of M.S. Degree (Branch – II) in Orthopaedic Surgery.

PLACE DR. SENTHIL.P

DATE:

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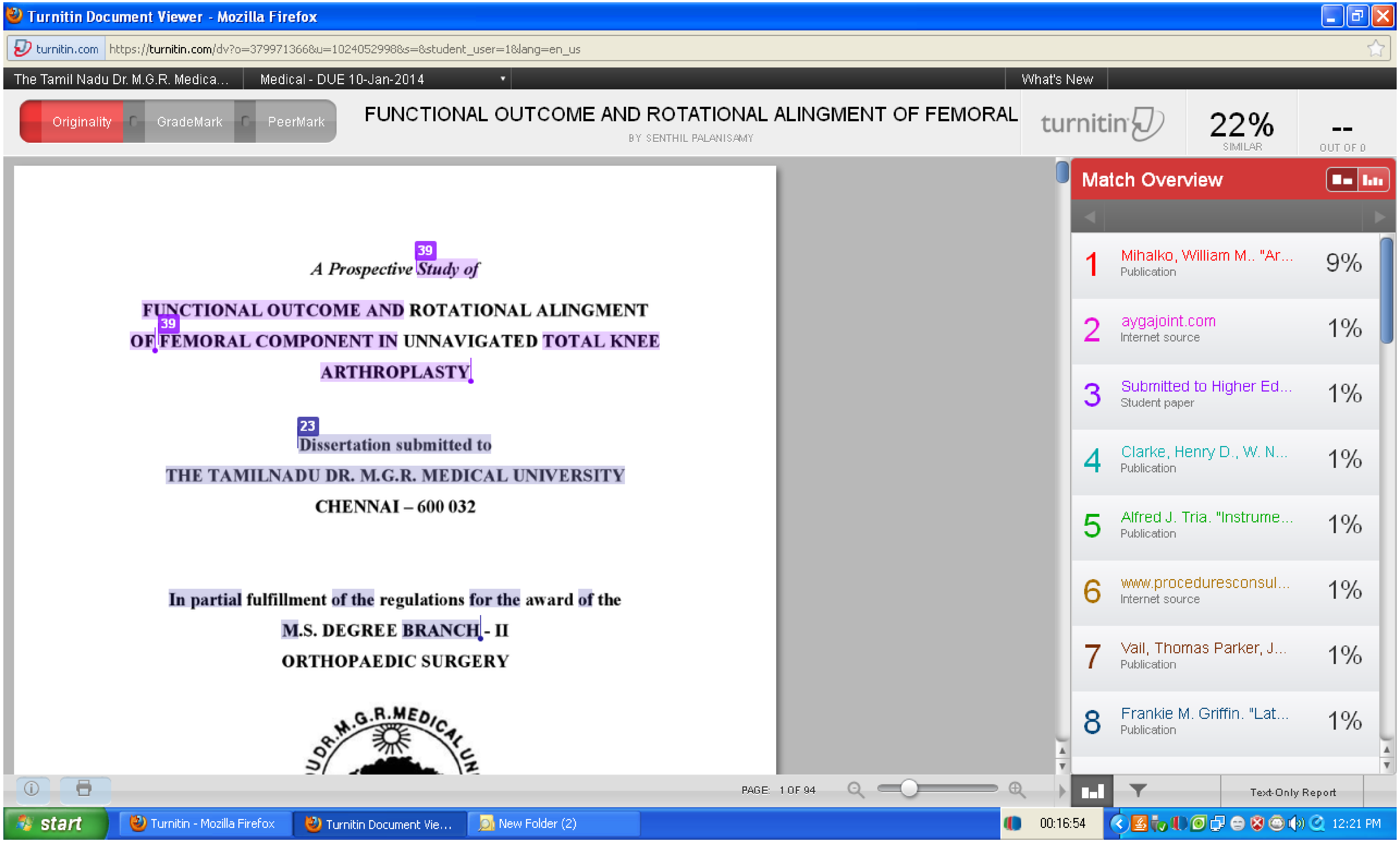
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A Prospective Study of

FUNCTIONAL OUTCOME AND ROTATIONAL ALINGMENT OF FEMORAL COMPONENT IN UNNAVIGATED TOTAL KNEE ARTHROPLASTY

ABSTRACT

Introduction:

Arthritis is the most common disabling disease that affects millions of people in our country. The common causes of knee arthritis include Osteoarthritis (OA), Rheumatoid Arthritis (RA), Juvenile Rheumatoid Arthritis, Post traumatic Arthritis, Secondary Osteoarthritis and other types of inflammatory arthritis. The incidence of osteoarthritis is increasing with increase in ageing population. The surgical management of Osteoarthritis varies from soft tissue interposition arthroplasty to surface replacement arthroplasty. In surface replacement arthroplasty different types of prosthesis were developed to address the complex kinematics of the knee joint.

Various systems are available with specific features regarding the geometry of the components, the degree of conformity of the articulating surface and the anchoring technique. Various implant designs such as cruciate substituting and cruciate retaining prosthesis are available to improve the functional outcome. The purpose of the study is to prospectively study the functional outcome and rotational alignment of femoral component in unnavigated Total Knee Arthroplasty.

Materials and methods:

In our study 20 cases of arthritis knee treated with cemented Total Knee Arthroplasty. Both cruciate retaining and cruciate substituting

prosthesis were used. Out of 20 cases 12 were males and 8 females, left side is more commonly involved than right side. The outcome was measured using the knee society scoring system at 6months and 1 year. The Knee Society Scoring system is subdivided in to a knee score that rates only the knee joint itself and a functional score that rates the patient's ability to walk and climb stairs.

Post operatively the rotational alignment of the femoral component was measured by an angle formed between the transepicondylar axis and posterior codylar line of the prosthesis in two dimensional CTscan.

Results:

In our study there is significant improvement in knee society scoring system post operatively. The rotational alignment of the femoral component ranges between 4.1 degrees to 11 degrees of external rotation. The average post operative Knee Clinical Score was 91.6. The average post operative Knee Functional Score was 86. In our study out of 20 cases anterior knee pain was noted in 6 cases, superficial infection in 2 cases which was treated with culture sensitive antibiotics and notching of anterior femoral cortex in 1 case.

Conclusion:

Total Knee Arthroplasty improves the functional ability of the patient and the ability of the patient to get back to pre-disease state, which is to have a pain free mobile joint, as reflected by the improvement in the post-op Knee Clinical Score and Knee Functional Score.

It is possible to achieve the rotational alignment of the components correctly in unnavigated Total Knee Replacement with appropriate surgical techniques, so that the complications due to malalingment of the components can be avoided.

Key words:

Arthritis, cruciate retaining prosthesis, cruciate substituting prosthesis, knee society scoring system, transepicondylar axis, posterior condylar line, rotational alignment.

INTRODUCTION

Arthritis is the most common disabling disease that affects millions of people in our country. The common causes of knee arthritis include Osteoarthritis (OA), Rheumatoid Arthritis (RA), Juvenile Rheumatoid Arthritis, Post traumatic Arthritis, Secondary Osteoarthritis and other types of inflammatory arthritis. The incidence of osteoarthritis is increasing with increase in ageing population.

Osteoarthritis is a chronic and painful disease without a known medical cure. Osteoarthritis causes pain and loss of movement in the knee that lead to difficulty in performing daily activities. Medicines can relieve the pain but they cannot cure the underlying pathology. In most arthritic knees, some degree of instability, deformity, contracture or a combination of these elements, can be found.[1,2,3]

The concept of improving the knee function by modifying the articular surface has received the attention since the 19th century. Though there are many advances in biomedical technology in last 20 years, persons with destructed joints by osteoarthritis find renewed hope in Total Knee Arthroplasty.

The surgical management of Osteoarthritis varies from soft tissue interposition arthroplasty to surface replacement arthroplasty. In surface replacement arthroplasty different types of prosthesis were developed to address the complex kinematics of the knee joint.

Various systems are available with specific features regarding the geometry of the components, the degree of conformity of the articulating surface and the anchoring technique. Various implant designs such as cruciate substituting and cruciate retaining prosthesis are available to improve the functional outcome.

The goals of Total Knee Arthroplasty include

1. Pain relief.
2. Restoration of normal limb alignment and
3. Restoration of the functional range of movement.

A successful outcome needs precise surgical technique, sound implant design and kinematics with appropriate materials and compliance of patient in rehabilitation.

The use of accurate instrumentation and an understanding of the basic principles inherent to the instruments are necessary to implant reproducibly well-aligned prostheses. Computer-assisted navigation is being used by some surgeons to try to improve the reproducibility of component alignment.[4]

While performing the Total Knee Arthroplasty, the rotational alignment of femoral and tibial components play a crucial role in determining the functional outcome and polyethylene wear.[5] Range of motion and stability are the two key factors in the success of total knee arthroplasty. Both features relate intimately to the kinematics of the knee joint.[6-7]

Primary malalignment and inappropriate positioning of the femoral component, in particular may lead to[8]

1. Patella maltracking.
2. Anterior knee pain and
3. Flexion instability.

The rotational alignment of the femoral component can be measured post operatively by

1. Conventional radiographs.
2. Axial two-dimensional (2D) CT scan and
3. Axial three-dimensional (3D) reconstructed CT scan.

It is measured post operatively by the angle between transepicondylar axis of femur and posterior condylar line of the prosthesis.[9]

The functional outcome of Total knee Arthroplasty can be assessed by using the Knee Society Score System. The Knee Society Scoring system is subdivided in to a knee score that rates only the knee joint itself and a functional score that rates the patient’s ability to walk and climb stairs.

This dual rating system eliminates the problem of declining knee scores associated with patient infirmity.[10] Rotational alignment of femoral component and the functional outcome has been assessed in this study.

AIM OF THE STUDY

The aim is to prospectively study the “functional outcome and rotational alignment of femoral component in unnavigated Total Knee Arthroplasty” at the Department Of Orthopaedics and Traumatology, Government Mohan Kumaramangalam Medical College, Salem.

HISTORICAL REVIEW

The evolution of Total Knee Replacement in its modern form is three and half decades old. In the 19th century, there was evolution in the management of arthritis knee that the function of knee joint can be significantly increased by modifying the articular surface of femur and tibia.

The evolution of various surgeries for total knee arthroplasty:

1861	Fergusson	Resection arthroplasty
1863	Vermeil	Interposition arthroplasty
1920-1930	Campbell	Fascial graft interposition
1940 1942	Campbell and Boyd Smith Peterson	Mold hemiarthroplasty
1950	Walldius, shiers	Hinged implants with intramedullary stems
1971	Gunston	Femoral roll back with PMMA.
1973	Coventry	Geomedic knee arthroplasty

In 1860, Verneuil introduced that the articular surface can be reconstructed by using fascia lata, pig bladder, nylon, and cellophane. In 1860, Ferguson resected the entire knee joint, so that there is a mobility of newly created subchondral surface.[11]

The first modern type of total knee replacement was designed by Gluck, who in 1890 presented a concept of surface replacing with the use of ivory components attached to the bone with cement made of colophony, pumice and plaster of Paris. However, neither the ivory nor the cement could withstand the forces applied to the knee and infection became a major problem.

Campbell in 1940 reported that instead of soft tissue interposition, metallic components can be used but the results were unsuccessful. The evolution of knee arthroplasty that occurred in parallel with the interposistion arthroplasty and then by the surface replacement.[12] (Fig.1)

Fig.1. Willis C. Campbell

In 1957, hinged prosthesis was developed by Waldius, which was initially made of acrylic and then by metal.[13] In 1965 Shiers described a similar type of device but the mechanical characters were simpler than the earlier. Both these designs were uncemented. Later it was followed by the development of GUEPAR hinged prosthesis which was a cemented model with axis of rotation was placed more posteriorly. Loosening and infection continued to be frequent as in previous hinged designs. More recent versions of hinged prosthesis have included the spherocentric knee and the kinematic rotating hinge.

In 1966, MacIntosh introduced different type of hemiarthroplasty for treating the painful varus and valgus deformities of the knee.[14]Initially the acrylic prosthesis was inserted on the tibial side to correct deformity, restore stability and relieve pain. Later metallic prosthesis was used instead of acrylic prosthesis.

The work of Sir John Charnley on total replacement of the hip joint with low friction arthroplasty, introduced in 1958 had generated surgical and engineering interest in applying such a concept to the knee. Surgeons at St.George's hospital in Hamburg in 1971 had designed a sledge type of prosthesis. In 1970 at Hospital for Special Surgery, Peter Walker, Ranawat CS, Insall JN developed a duo-condylar and unicondylar devices with low conformity and anatomic geometry to allow laxity and freedom of motion and with curved condylar shapes to reduce bone resection.[15] (Fig.2)

The modern era of total knee replacement began with Gunston (1971) who influenced by the work of Charnley in 1968 designed a surface replacing prosthesis with a metal component articulating against a polyethylene component and both components attached to the bone with bone cement made of polymethyl-methacrylate (PMMA). The design was a unicompartmental prosthesis suited for either the medial or the lateral compartment or both.

Freeman and Swanson (1972) designed unlinked total knee prosthesis of condylar type and inserted the first one in 1970. Modification of this design is still in clinical use as Freeman-Samuelson prosthesis.


Fig.2.John Nevil Insall

Insall in 1973 introduced the Total Condylar Prosthesis.(Fig.2)This was a semiconstrained prosthesis with the femoral component made of metal and the tibial component made of polyethylene. The femoral component had an anterior flange for articulation against polyethylene patellar component. The tibial component was cup-shaped for stability, had an intercondylar eminence and an intramedullary peg to enhance fixation. This concept is still considered to be "the gold standard" for Total Knee Arthroplasty. In 1970s, the failure rates in knee arthroplasty were higher than in hip arthroplasty (Tew and Waugh 1982). The major cause for failure was loosening of components, especially on the tibial side (Moreland 1988). Biomechanical

Fig.3. Total Condylar Prosthesis

studies indicated that a metal reinforcement of the polyethylene tibial component would lead to lower and more evenly distributed stresses to the underlying bone and thus improved fixation (Bartel et al. 1982, Reilly et al. 1982, Lewis et al. 1982). The designs of total knee prostheses during the 1980s were therefore changed to metal-backed tibial components and also to less conforming articular surfaces in order to decrease forces acting on the implant-bone interface.

Total Condylar Prosthesis (TCP) leads to unsatisfactory outcome in terms of tendency to subluxate posteriorly and inability of the prosthesis for "rolling back" mechanism. In 1978 Insall- Burstein developed two types of prosthesis

1. Posterior cruciate substituting prosthesis.
2. Posterior cruciate retaining prosthesis.

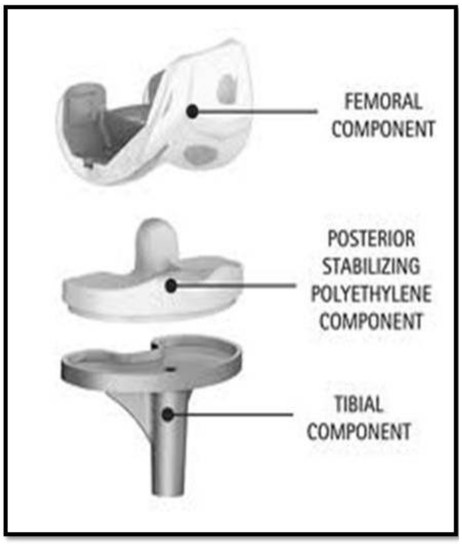


Fig.4. Posterior Cruciate Retaining Prosthesis


Fig.5.Posterior Cruciate Substituting Prosthesis

In PCL substituting prosthesis the central cam mechanism was added to the articular surface geometry of TCP.[16] Most of the newer total knee designs are based on Insall-Burstein and kinematic designs. (Fig.4)

During the late 1980s and 1990s, patellofemoral complications developed and increased the rate of reoperation in TKA. To overcome these patellofemoral complications, newer designs were developed with asymmetrical anterior flanges in the femoral component to resist patellar subluxation and to incorporate larger areas of patellofemoral contact.

Fig.6. Deep Dish Design

The recent deep-dish designs are similar to total condylar prosthesis that uses sagittal plane concavity or dishing alone to control anteroposterior stability. Laskin et al. found that there is no difference in functional outcome by comparing the deep dished components with the posterior stabilized devices using the same femoral component. When compared to cruciate sacrificing device with cam mechanism these designs doesn't need bone sacrifice in the intercondylar region of femur, which can predispose to fracture. They found that the posterior impingement during flexion can be avoided by the proper balancing of flexion and extension gap.[17]

VARUS AND VALGUS CONSTRAINED PROSTHESES

Insall and others developed the constrained condylar knee (CCK) from the posterior-substituting design. These prosthesis had large central post in the tibial polyethylene insert, which constrain against the medial and lateral walls of a deepened central box of the femoral component.[18] Initially these prosthesis had cemented intramedullary stems on the femoral and tibial component and recently modular press fit types had developed. (Fig-7)

Fig.7. Varus-Valgus Constrained Prosthesis

The constrained prosthesis was mainly used for revision arthroplasty and for difficult primary arthroplasty with severe deformity and ligamentous instability.

Donaldson et al. reported no failures in 17 primary knee arthroplasty in 4 year follow up and 5 failures in 14 revision arthroplasties.[19] Most of the recent knee models are variation of the constrained condylar prosthesis.[20]

MOBILE BEARING PROSTHESES

Beuchel and others developed the meniscal bearing version of low contact stress prosthesis including many features in the oxford knee.[21]These designs had individual polyethylene menisci that articulate with the femoral component above and with tibial component below. The anteroposterior course of the menisci is controlled by the dove tailed arcuate grooves on the tibial base plate. This modification of the Oxford design leads to decrease in incidence of posterior extrusion of the menisci. Jordan, Olivo, and Voorhorst reported a 94% 8-year survival rate for the cement less version of this design.[22]

The LCS total knee system has rotating platform with congruent tibiofemoral geometry and the tibial polyethylene is free to rotate within the tibial base plate. The rotational dislocations of the tibial inserts are rare in these designs and exhibited excellent longevity. (Fig.8)

Fig.8. Mobile Bearing Prosthesis

Callaghan et al. reported a 100% prosthesis survival rate in 82 patients at a minimum of 9-year follow-up in cemented rotating platform LCS design.[23]

The advantages of the mobile bearing prosthesis are low contact stress between the articulating surface, self alignment and rotational motion of the tibial polyethylene during gait.

UNICOMPARTMENTAL PROSTHESES

In 1970 marmor introduced unicompartmental arthroplasty. It is advocated in knees with disease restricted to single compartment. These prostheses replace the articular surface of both femur and tibia in the diseased compartment. Better results seen in with replacement of the lateral compartment than of the medial compartment. (Fig.9)

Fig.9. Unicompartmental Prosthesis

The Marmor prosthesis the tibial component was flat and all polyethylene.[24]In unicompartmental knee arthroplasty the cruciate ligaments, the patellofemoral joint and the opposite tibiofemoral compartment are preserved. This results in near normal knee kinematics, easy rehabilitation and greater range of motion than total knee arthroplasty.[25]

Insall, Stern and Padgett reported that the conversion of unicompartmental knee arthroplasty in to tricompartmental arthroplasty needs special components and bone grafting or cementation to fill the bony defect in 76% of patients. Newer designs with limited tibial resection lead to decrease in incidence of significant bony defects during revision procedures.

ROLE OF THE POSTERIOR CRUCIATE LIGAMENT IN TOTAL KNEE ARTHROPLASTY

The retention of posterior cruciate ligament increases the range of motion by effective femoral roll back mechanism. In posterior cruciate ligament substituting prosthesis the femoral back is achieved by a tibial post and femoral cam mechanism. Both PCL substituting and PCL retention prosthesis had good range of functional outcome particularly the flexion, when compared to total condylar design. The merits and demerits of the PCL retaining and PCL substituting prosthesis are still in debate. There is no significant difference in functional outcome between these two prosthesis and produces excellent outcome in 10 to 15 year follow up.

In PCL-substituting prosthesis, posterior displacement of femur during flexion is produced by the tibial post contacting with the femoral cam. Hence the resultant stress is borne by the prosthetic construct and transferred to the bone cement interface. The resultant stress at the bone cement interface lead to loosening of the prosthesis and high failure rates in posterior cruciate substituting prosthesis than posterior cruciate retaining prosthesis. The loosening rates of these two designs are similar at 10-year follow-up. However, at least for the initial 10 to 15 years after surgery, this argument does not seem to be valid.

Gait analysis by Andriacchi and Galante, Kelman et al., and others found that the gait is more symmetrical with PCL-retaining prosthesis when compared to PCL-sacrificing or PCL-substituting designs. It is postulated that the gait abnormalities may be due to inadequate femoral roll back or due to loss of proprioceptive role by the PCL. These observations lead to retention of posterior cruciate ligament.[26]

Wilson et al. analyzed the gait in the PCL -substituting knees by comparing it with the normal controls and found that the femoral roll back was more uniform in PCL substituting designs. It contradicts the conclusions of earlier studies.[27]

Both the PCL-retaining and PCL substituting designs do not tolerate elevation in the joint line. But when compared to the PCL retaining designs the PCL substituting designs can tolerate with mild elevation in native joint line.

The elevation in native joint line alters the patellofemoral joint function leading to post operative pain and subluxation.[28]The relationship of the patella and the joint line is altered more in PCL substituting designs.

In PCL substituting designs “box” cut was made in the femoral side to accommodate the cam mechanism. The degree of flexion at which the patella contacts the box varies in posterior substituting designs. The "patellar clunk syndrome" termed by Hozack et al is a potential complication of PCL-substituting designs.[29] Insall recommended to do an limited synovectomy on the posterior surface of quadriceps tendon as a prophylactic measure to prevent this condition.

Maloney et al stated that the posterior cruciate ligament is diseased in most of the patients with arthritis knee and it is difficult to reproduce the near normal function using the PCL retaining prosthesis.[30]

Laskin et al. reported that the use of PCL retaining designs in patients with flexion contractures leads to poor post operative functional outcome particularly the flexion and leads to residual flexion contractures. Since the contracted PCL acts as a tether and prevent the deformity correction.[31]

Faris et al. found no correlation between the preoperative deformity and postoperative outcome in a large series of knees treated with PCL retention.[32]

The tibial polyethylene wear is more in PCL retaining designs because the tight PCL may increase the polyethylene contact stress, particularly during femoral roll back in flexion. Dennis et al reported that the paradoxical anterior translation of the tibia during flexion in a poorly functioning PCL retaining design may lead to excessive polyethylene wear.[33]

Conversely Puloski et al and O'Rourke et al reported that the tibial post is the common site for wear and occasional breakage in PCL substituting designs. It is due to impingement of the femoral component on the tibial post in hyperextension. This type of polyethylene wear is more particularly when the femoral component is fixed in flexion or the tibial component is fixed with excessive posterior slope.[34]

Prosthetic fixation in total knee arthroplasty with polymethyl methacrylate (PMMA) had shown long-term durability than cementless fixation. Retrieval analysis of cementless implants by Cook, Dichiara et al., Mayor and Collier, and Ranawat, Johanson, and Rimnac showed that there is little bony ingrowth in the removed tibial trays that too centered around the fixation screws.[35-36]

Clinically, many of the early cementless TKA systems had poor survival rates, Duffy, Berry, and Rand reported that the 10-year survivorship with the cement less Press- Fit Condylar design was 72% and 94% 10-year survivorship with similar cemented TKA.[37]

Barrack et al. reported 8% revision rate in a 2 year follow up of cementless mobile-bearing design compared with none of its cemented counterparts. He stated that the major cause for the revision was tibial subsidence due to lack of bony ingrowth.[24] Osteolysis also has been reported more frequently with cementless prostheses, possibly because of greater access of wear debris to the cut bone surfaces with incomplete bony ingrowth and through screw holes in tibial trays.

Engh et al. reported high rate of osteolysis in designs with patches of porous coating on the undersurface of tibial base plate with intervening areas of smooth metal. Berger et al reported 12% tibial osteolysis and 8% tibial loosening in 131 cementless procedures in 11-years follow-up. [38]

In general, the results of total knee arthroplasty in long-term reports are very good with prosthetic survival rates of 92–99 % at 14–17 years (Font-Rodriquez et al. 1997, Gill and Joshi 2001, Keating et al. 2002).

ANATOMY

The embryological development of knee joint begins with the formation of leg bud at 28 days followed by the development of femur, tibia and fibula with in 37days. The knee joint arises from blastemal cells with the formation of patella, cruciate ligaments and menisci by 45 days.

Fig.10. Synovial Joint

The knee joint is of synovial variety. It is a complex hinge joint which contains three distinct and partially separated compartments. The knee joint is formed by condyles of femur, tibia and patella. (Fig.10)

ARTICULATION:

The femoral condyles articulate with tibial condyles below and behind to form condylar joints, and with the patella in front to form the saddle joint. This complex arrangement provides fulcrum for action of flexor and extensor muscles during joint motion. The intracapsular and extracapsular ligaments provide stability to the joint.

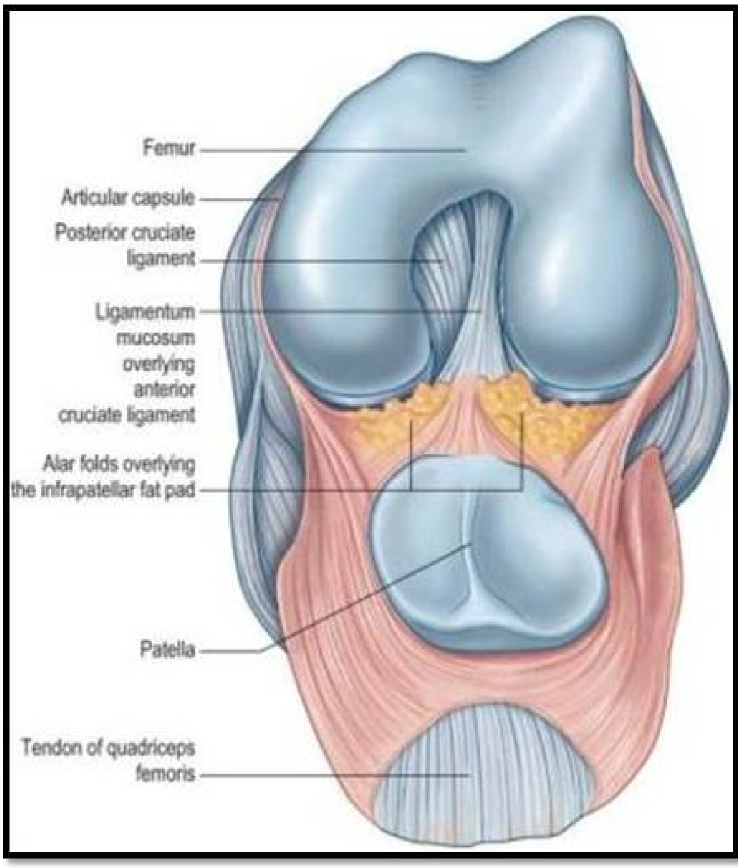


Fig.11. Capsules of the Knee Joint

CAPSULE

The fibrous capsule is very thin and attached to articular surface at their margins. The capsule is deficient anteriorly through which the synovial membranes herniate and forms the suprapatellar pouches. (Fig.11)

The deficient anterior portion of the capsule is supported by quadriceps femoris, patella and the ligamentum patellae. On each side of patella, the capsule is strengthened by the expansions from tendons of vastus lateralis and medialis. On the posterior aspect, capsule is strengthened by the oblique popliteal ligament which is the expansion of semi-membranous muscle. Behind the lateral tibial condyle there is an opening in the capsule which permits the tendon of popliteus.

SKELETAL FRAMEWOEK OF THE KNEE JOINT

FEMUR

The distal end of femur is widely expanded for the transmission of weight to the tibia. It has two condyles, the medial and lateral. Both condyles are confluent and continuous with the shaft anteriorly and posteriorly separated by the intercondylar notch. (Fig.12)

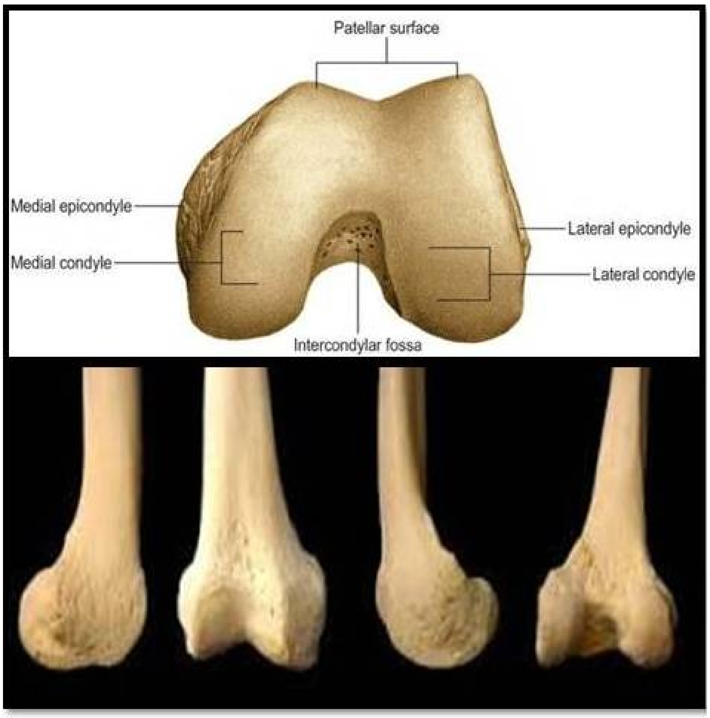


Fig.12. Distal Femur

Articular surface of the condyles are broad, like an inverted U for articulation with tibia and patella. The lateral femoral condyle is larger anteroposteriorly than medial condyle. The most prominent point on lateral condyle is the lateral epicondyle.

The lateral epicondyle is separated from the articular margin by a short groove through which the popliteus tendon passes through. In the sagital axis the lateral femoral condyle extends more anteriorly when compared to medial condyle.

The intercondylar fossa separates the condyles and it is limited in front by the distal border of patellar surface and behind by the intercondylar line. The medial and lateral wall of the fossa is devoid of vascular foramina whereas the rest of the fossa is rough and pitted by vascular foramina.

The patellar surface or the trochlear groove extends more proximally on the lateral side. This area articulates with the medial vertical facet and stabilizes the patella.

The rotational alignment of femoral component was measured by using true transepicondylar axis. The true transepicondylar axis is defined as the line connecting the prominent point on the lateral epicondyle and the base of sulcus at the medial femoral condyle.

TIBIA

The proximal end of tibia consists of medial and lateral condyles, an intercondylar area and tibial tuberosity. The tibial condyles overhang the proximal part of the shaft. The medial tibial plateau is oval, concave and longer, while the lateral tibial plateau is convex. (Fig.13)

Fig.13. Proximal Tibia

In the sagital plane, tibial condyles had 10% posterior slope in relation to the long axis of the shaft. The posterior slope in tibia decreases with increase in age.[7] Trabecular bone of the tibial epiphysis and metaphysis are responsible for the load transmission. Compressive strength and stiffness depends on proximal tibial bone density and trabecular structure.

The medial tibial plateau is stronger than lateral tibial plateau. Strength of the bone is reduced at both plateaus towards periphery. Trabecular bone strength is significantly reduced at a distance of 5 mm from the surface. Preservation of bone stock of the tibial plateau should be considered in total knee arthroplasty, because optimum support is achieved by resecting 10 mm or less of tibial plateau. Excessive resection results in prosthetic loosening and alteration of desired component position.

PATELLA

It is the largest sesamoid bone. The nutrient vessels perforate through the anterior surface of the patella. The articular surface is smooth and crossed by a vertical ridge, which fits the intercondylar groove on the femoral patellar surface and divides the patellar articular surface into medial and lateral facet. (Fig.14)

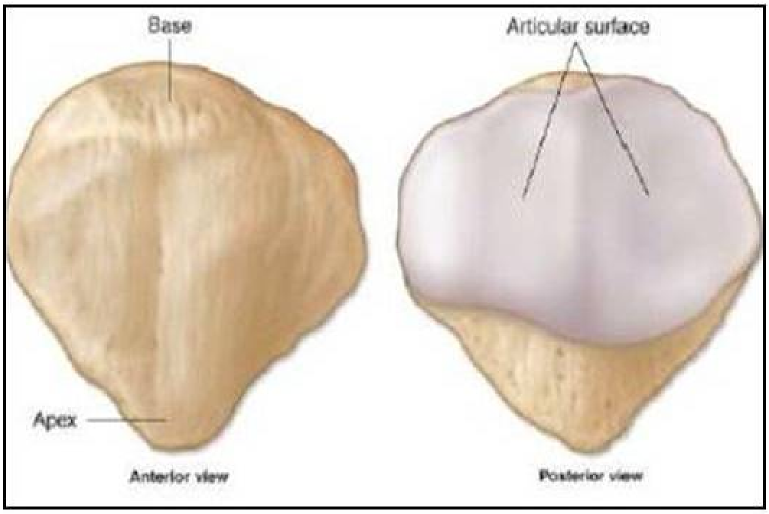


Fig.14. Patella

The seventh 'odd' facet is present as a narrow strip and it contacts the medial femoral condyle in extreme flexion.[11] The medial and lateral borders are thin and converge distally to provide attachment to the medial and lateral retinaculum.

The patella contains uniformly dense trabecular bone, covered by a thin compact lamina.

LIGAMENTS

The ligaments may be divided into two types

1. Extra capsular ligaments
2. Intra capsular ligaments

EXTRACAPSULAR LIGAMENTS

The patellar tendon is attached to the inferior pole of patella above and below to the tibial tuberosity. It is the continuation of central portion of quadriceps tendon. (Fig.15)

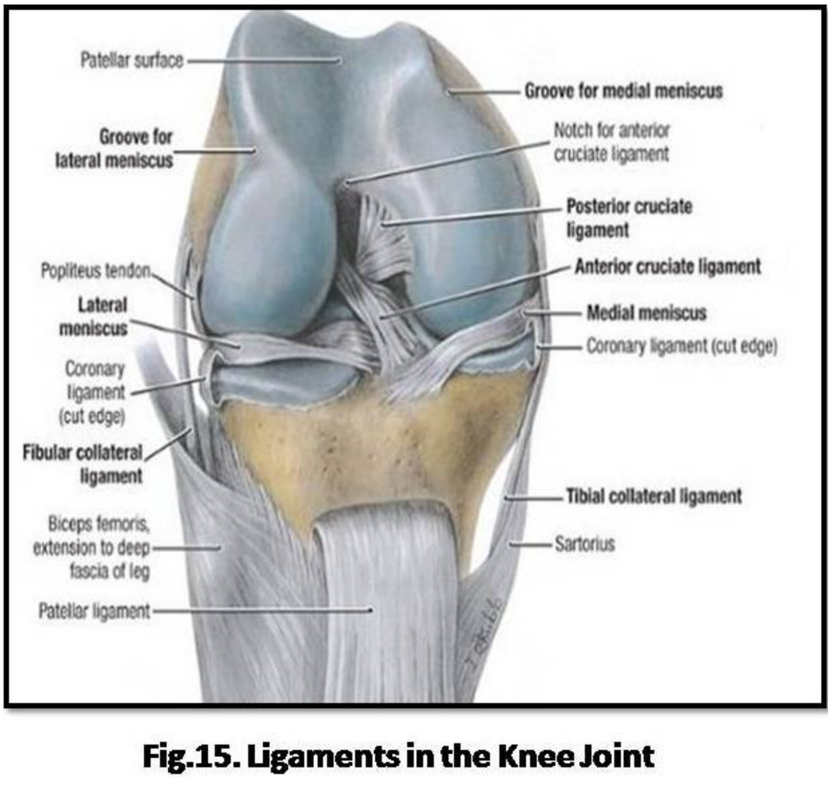


Fig.15. Ligaments in the Knee Joint

Medial collateral ligament consists of superficial and deep parts. The superficial fibres are attached to the margins of the medial meniscus. The pes anserinus bursa overlies the superficial collateral ligament. The centre of the medial epicondyle is an indentation or sulcus where the deep fibres of the MCL insert. (Fig.16)

The lateral collateral ligament arises from the lateral epicondyle of the femur and it lies superficial to the popliteus tendon and deep to the lateral patellar retinaculum.

The oblique popliteal ligament is derived from the semimembranous muscle. It provides support to posterior aspect of the joint capsule.

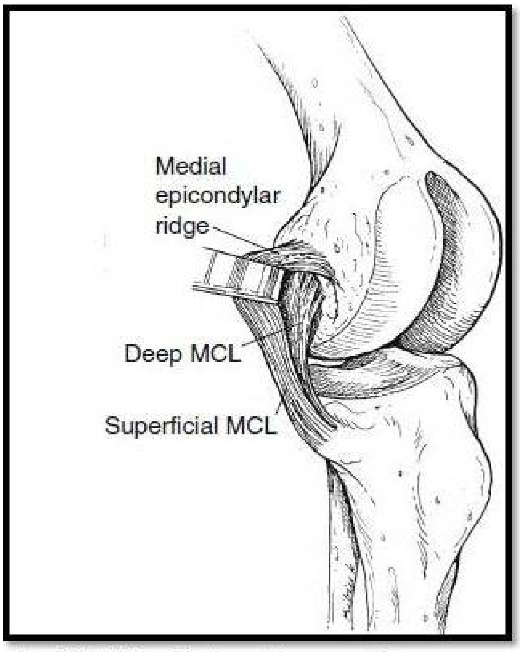


Fig.16.Medial collateral ligament

INTRACAPSULAR LIGAMENTS

The cruciate ligaments cross each other and are named according to their tibial attachment. The synovial membrane reflects posteriorly in to the adjoining parts of the fibrous capsule. (Fig.17)

ANTERIOR CRUCIATE LIGAMENT (ACL)

The anterior cruciate ligament is attached to the intercondylar area of the tibia and ascends posterolaterally, twisting on itself to get attached in to posteromedial aspect of lateral femoral condyle. It consists of three bundles and named according to their tibial attachment into anteromedial, intermediate and posterolateral fibres. It prevents the tibia from anterior displacement and it is taut in flexion.

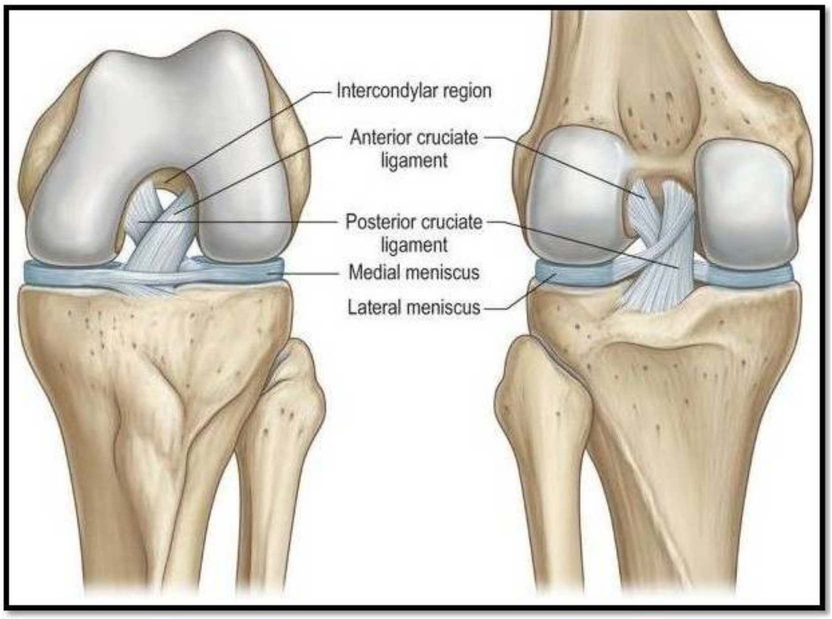


Fig.17.Cruciate ligaments.

POSTERIOR CRUCIATE LIGAMENT (PCL)

The posterior cruciate ligament is thicker and stronger when compared to the anterior cruciate ligament. It arises from the posterior intercondylar notch of tibia and it ascends to get attached to lateral surface of the medial femoral condyle. It consists of two types of fibers, anterolateral and posteromedial. They are named according to their femoral attachments. The anterolateral fibres taut in flexion while the posteromedial fibres taut in extension. The posterior displacement of tibia over femur is prevented by the posterior cruciate ligament.

MENISCI

Menisci (semilunar cartilages) are crescentic, intracapsular, fibrocartilagenous laminae**.** It deepens the tibial condyles to receive the femoral condyles. The thick peripheral borders are convex and vascular, while the inner regions are avascular. The meniscal horns are richly innervated. There are no innervations in the central third (Gronblad et al 1985). (Fig.18)

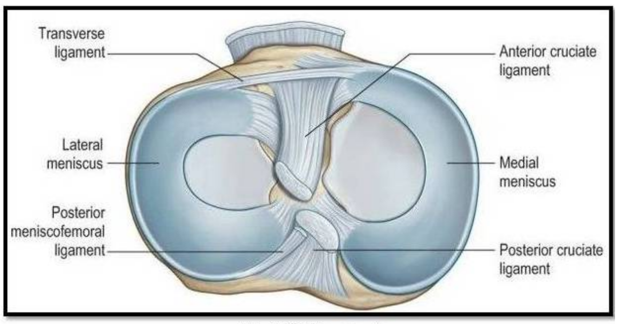


Fig.18.Menisci

Each menisci covers two third of tibial articular surface. The thinner collagen bundles parallel to the surface line the inner part of the articular surfaces and resists the compressive force, while the outer portion is being covered by synovium and capable of resisting the tensional forces. Increasing the congruity of the articulation helps in spreading the load and it also provides proprioceptive feedback. It provides lubrication and Cushing effect to the underlying bone from the considerable forces generated during extremes of flexion and extension.

The semicircular medial meniscus is attached to the anterior tibial intercondylar area in front of the anterior cruciate ligament by its anterior horn. The tibial attachment of the meniscus is termed as ‘coronary ligament”. The relatively fixed medial meniscus moves much less when compared to the lateral meniscus because of the attachments.

The anterior horn of lateral meniscus being attached in front of the intercondylar eminence, the posterior horn is attached behind the eminence. As the popliteus tendon is attached to the lateral meniscus, the mobility of its posterior horn may be controlled by the meniscofemoral ligaments and by the tendon of popliteus.

MUSCULATURE AROUND THE KNEE JOINT

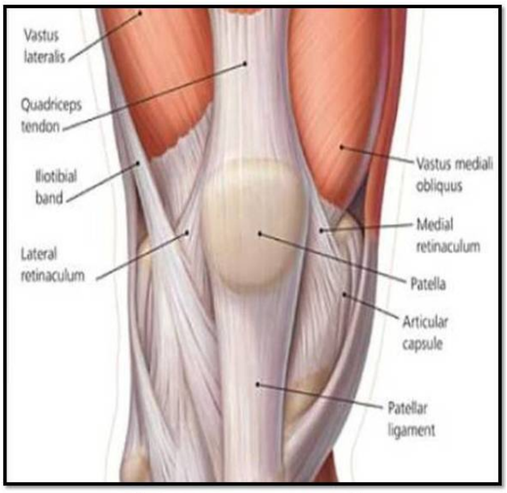


Fig.19.Extensor Mechanism

The knee joint's extensor mechanism includes the quadriceps muscle, patella, medial and lateral retinaculum and the patellar tendon. The quadriceps tendon represents an aponeurosis of four muscles in the anterior compartment of the thigh. Centrally, the rectus femoris continues over the anterior surface of the patella and is the only quadriceps component with continuity in the infra patellar ligament. (Fig.19)

The fibres of vastus medialis pass downwards and forwards at an average angle of 15° to the long axis of femur into an aponeurosis on the deep surface of the muscle which is attached to the medial border of patella and quadriceps tendon.

The vastus medialis obliqus, originate largely from the adductor magnus tendon and insert into the medial border of the patella. It plays a crucial role in the function of patellofemoral joint. The vastus lateralis fibers are oriented at an angle of approximately 30^0 to the rectus tendon. The lateral retinaculum contains vastus lateralis fibres inserting into the superolateral corner of patella.

The rectus femoris fibres that extend distally over the anterior surface of the patella contribute to the infrapatellar tendon. The tendon ranges in length from 3.5 to 5.5 cm. The infrapatellar tendon is inserted at the anterior aspect of tibia. The tendon and its insertion must be carefully protected during the exposure of the knee joint.

An arthritic knee with an extensor mechanism contracture and limited knee flexion is especially vulnerable. A safe exposure and improved postoperative flexion may be achieved with a modified V-Y quadricepsplasty for a quadriceps contracture and a tibial tubercle osteotomy for a patellar tendon contracture. [6]

The hamstring musculature is made up of the gracilis, semimembranosus and semitendinosus medially and the biceps femoris laterally. On the medial side, the semimembranous has an extensive insertion and the gracilis and semitendinous combine with the sartorius to create the pes anserinus (goose foot).The sartorius muscle originates from the Anterior Superior Iliac Spine (ASIS) and it runs down in front of thigh, with innervation from the femoral nerve. Its insertion is expansive as a fascial covering (layer I) surrounding the deeper insertions of the remaining two pes tendons. The gracilis muscle originates from the pubic arch and runs medially in the thigh to insert below the joint line by approximately 4 cm, with innervation from the obturator nerve.

The semitendinosus originates from the ischial tuberosity, is innervated by sciatic nerve, and travels in the thigh on the surface of semimembranosus. On the medial tibia, its tendon gets inserted posterior to the gracilis. The semimembranosus muscle originates from the ischial tuberosity via a long tendon and courses medially and deep to the biceps femoris, with five insertions on the medial knee. It provides a strong expansion posteriorly and medially to the knee, continuing to form the posterior oblique ligament of the knee with condensations of layers II & III. It receives innervations from the sciatic nerve.

The biceps femoris arises in the form of two heads, the long head from the ischial tuberosity in common with the semitendinosus whereas the short head arises from the linea aspera and lateral intermuscular septum. The innervation is dependent on the belly, the long head via the sciatic nerve and short head via the lateral popliteal nerve.

Gastrocnemius muscle arises from two heads, the larger medial head is from posterior part of medial condyle, behind the adductor tubercle whereas the origin of the lateral head is from the lateral condyle. Gastrocnemius and soleus are collectively known as the triceps surae. The aponeurosis gradually narrows and receives the tendon of soleus on its deep surface to form the tendoachilles.

The popliteus originates as a 2.5 cm long, strong and intraarticular tendon from the lateral aspect of the lateral femoral condyle. It is inserted above the soleal line on the posterior surface of tibia. Due to its oblique orientation on the tibia, the popliteus is also a dynamic restraint to the tibial external rotation.

NEUROVASCULAR ANATOMY

Knee joint is supplied by genicular anastomosis around the joint. The anastomosis is between the medial and lateral superior and inferior genicular arteries, the descending genicular, the descending branch of the lateral circumflex femoral artery, the circumflex fibular and the anterior and posterior tibial recurrent arteries.

The popliteal artery is the continuation of femoral artery and divides into anterior and posterior tibial arteries at the level of proximal end of the asymmetrical crural interosseous space between the wide tibial metaphysis and the slender fibular metaphysis. The popliteal vessels are surprisingly close to the bone at the level of the tibial cut.

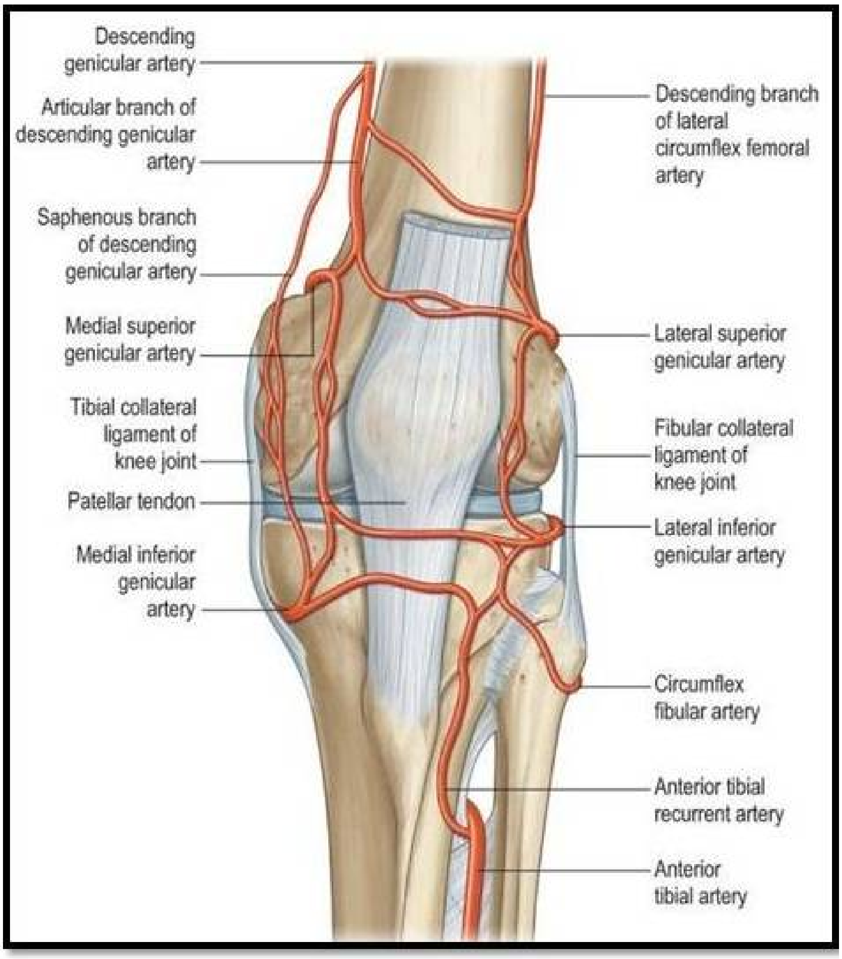


Fig.20. Blood Supply of the Knee Joint

An MRI study has documented this distance as 3-12 mm in extension and 9-15 mm in 90 deg flexion.

The patella is supplied by two systems of vessels, the midpatellar vessels penetrating the middle third of the anterior surface and the polar vessels entering the apex behind the patellar ligament.

A vascular anastamotic ring surrounds the patella, with oblique branches converging on the anterior surface. The distal half of patella is susceptible to ischemia if these vessels are damaged. Excision of prepatellar fat pad and extensive lateral release during the total knee arthroplasty may result in devascularization.

NERVES

The innervation of knee joint is from the obturator, femoral, tibial and common fibular nerve branches (Freeman & Wyke 1967). The infra patellar branch is the primary articular afferent branch from the saphenous nerve, which innervates the inferomedial capsule, the patellar tendon and the anterior skin. Transection of these branches with the medial skin incision during total knee arthroplasty may result in the bothersome numbness for the patient.

BIOMECHANICS OF THE KNEE

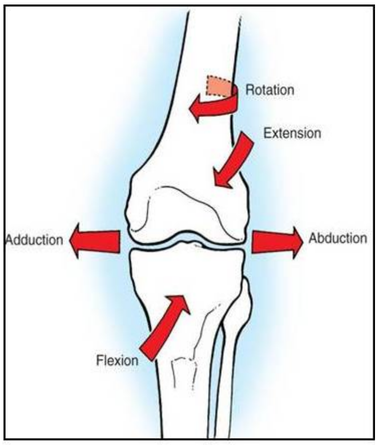


Fig.21.Biomechanics of Knee Joint

It is important to understand the biomechanics of the normal knee joint. The long term outcome of the total knee arthroplasty depends on the restoration of the near normal limb alignment. Failure to restore the normal biomechanics of the knee joint leads to tibiofemoral instability, patellofemoral complications, patellar fracture, stiffness, accelerated polyethylene wear, and implant loosening. (Fig.21).

The knee joint is a complex synovial joint which controls the center of body mass in all activities. Hence, this needs large range of movements in three dimensions and ability to withstand high stress. The knee movement during normal gait is more complex phenomenon. The knee joint is incongruent and potentially unstable compared to the hip joint. This variation allows the knee joint to function in six degrees of freedom. Knee motion in gait occurs in flexion and extension, abduction and adduction and rotation about the long axis of the limb.

The kinematics of the knee joint were studied by Kettlekamp and found that the normal gait needs 67 degrees of flexion during swing phase, 83 degrees of flexion for stair climbing, 90 degrees for descending stairs and 93 degrees to raise from a chair.[39]

The major movements of the knee joint occur in the sagital plane and minor degree of movements in a transverse plane. There is an external rotation of tibia during the terminal stages of extension to lock the knee joint. During flexion there is internal rotation of tibia to unlock the knee joint. This coupled phenomenon is known as "screw home mechanism". The knee flexion occurs around varying transverse axis and the posterior translation of the medial femoral condyle is more than the lateral femoral condyle.

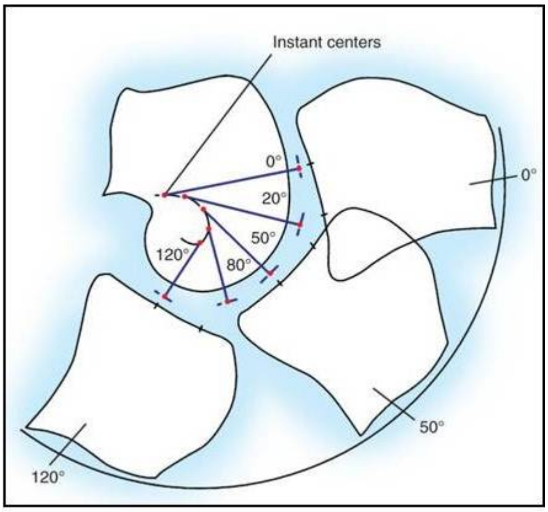


Fig.22.Tibio-Femoral Joint Motion

The planar motion of the two adjacent body segments can be described by the concept of instant center of motion. As one body segment moves over the other, at any instant, there is point that does not move. This point acts as center of rotation and has no velocity. This technique yields a description of motion at one point only and is not applicable if motion of 15 degree or greater exists in other planes. (Fig.22)

The understanding of the movement between the articulating surfaces in the knee joint is important for understanding the causes of polyethylene wear, instability and loosening of prosthesis in total knee arthroplasty.

Frankel VH et al analyzed the surface motion of the tibiofemoral joint from 90 degree of flexion to full extension in 25 normal knees and thereby determined the instant center pathway [40]

Muller explained that the rolling to gliding ratio can be controlled by crossed four bar linkage model. In this model the femoral and tibial insertions of both cruciate ligaments are represented by two cross bars. The cruciate bars linked together at their tibial and femoral attachments and this link forms the two additional bars of the four bar linkage. The four-bar crossed-link model guides the femoral and tibial surfaces past one another. The anterior and posterior motion of the femur over tibia is coupled with flexion and extension.

PATELLOFEMORAL MOTION

The primary function of the patellofemoral joint is to increase the lever arm for the extensor mechanism of the knee, thereby increasing the efficacy of quadriceps contraction. The length of the lever arm changes throughout the range of knee motion. The extensor lever arm will be maximum at 20 degrees of knee flexion. Maximum quadriceps force will be at the terminal stages of extension. Patella experience a joint reaction force during the transmission of forces from quadriceps to the patellar tendon. The posterior displacement is prevented by trochlea. The magnitude of force acting on the patella is determined by the degree of knee flexion and force transmitted across the patella. The joint reaction force over the patella is 2 to 5 times the body weight and maximum at the time of squatting.

The mean amount of patellar gliding for all knees is approximately 6.5mm per 10 degree of flexion between zero degrees and 80 degree and 4.5mm per 10 degree of flexion between 80 degree and 120 degree.

JOINT SURFACE

The constraints provided by the femoral and tibial joint surfaces are not adequate for functional stability. The distal femur is convex, whereas the proximal tibia is partially flat, slightly concave medially and slightly convex laterally. Hsieh and Walker found that geometric conformity of the condyles was the most important criteria for decreasing laxity under load bearing. They stated that in order to perform anterior or posterior, rotatory and medial or lateral movements, the femur must ride upward on the tibial curvature.

Similarly, to rotate the femur "screws out", giving an upward movement. Medial/lateral motion produces this effect to an even greater degree because of the tibial spines. This is called the "uphill principle". These authors concluded that under low loading conditions, the soft structures (ligaments, capsule and meniscus) provided joint stability and that as loading increases condylar surface conformity becomes the most important factor.

LIGAMENTOUS STABILITY

The ligament structures are able to resist translational forces and thus prevent translation of their bony attachments if the translation takes place in the direction of ligament fibers. This principle is particularly relevant provision of anterior and posterior translational stability. Li et al have shown at the hamstrings provide an active restraint to anterior displacement in the tibia. This restraint indicates that muscle contraction contributes to the stability of the knee joint by increasing the stiffness of the joint.

The collateral ligaments provide varus and valgus stability of the knee. The rotational forces are not resisted by the ligaments acting alone. Increased compressive force generated at the joint articular surface produce a torque that resists the rotation movement. Burstein and Wright have also indicated the importance of muscle forces contributing to knee joint stability in the frontal plane. At full knee extension the knee may be expected to show a balance of compressive forces between the medial and lateral compartments in response to axial loading.

JOINT LOADING

Understanding the loads across the knee joint is important for understanding knee prosthesis design and preference. The knee muscles are relatively inefficient because of small, effective moment arms compared with the external applied forces and moments. This constraint requires muscles to contract at high forces to maintain joint equilibrium. Consequently, knee joint shear and contact forces are surprisingly high in magnitude. Joint forces during stair ascent and descent are slightly higher than those used for walking. The forces increase during isokinetic exercise and in rising from chair and are greatest during downhill walking. Moreover, the peak forces during stair walking and exercise, either isokinetic or cycling, occurs at greater degrees of knee flexion.

LONGITUDINAL AND ROTATIONAL ALIGNMENT OF THE KNEE

The line drawn from the center of femoral head to the center of talar dome in a weight bearing anteroposterior view describes the mechanical axis of the lower limb. Normally, the anatomical axis of the femur and the tibia forms a valgus angle of 6 ± 2 degrees. Normally the mechanical axis will pass through the center of knee joint, but in knees with varus and valgus deformity, axis will pass through the medial and lateral side of the knee center respectively. (Fig.23)

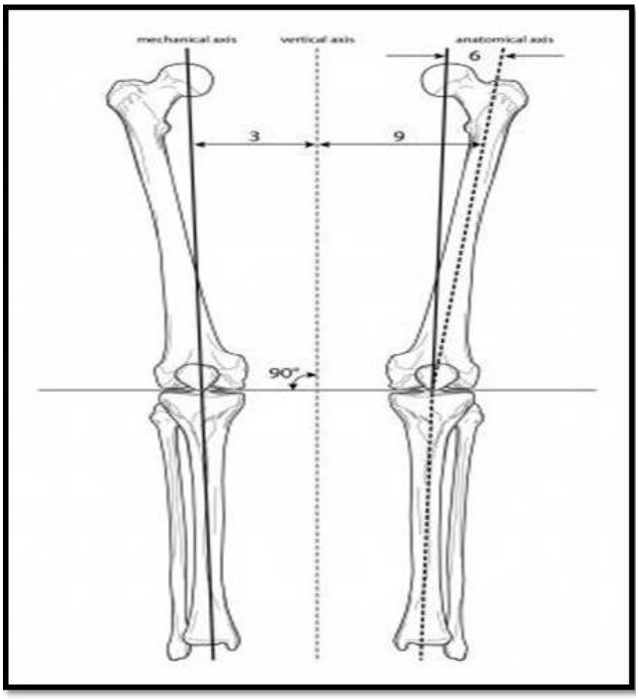


Fig.23. Axial alignment of the Knee Joint

The degree of varus and valgus deformity is measured between the mechanical axis of the femur and tibia, which extends from the center of femoral head to the center of intercondylar notch and the center of tibial plateau to the center of tibial plafond respectively.(Fig.24)

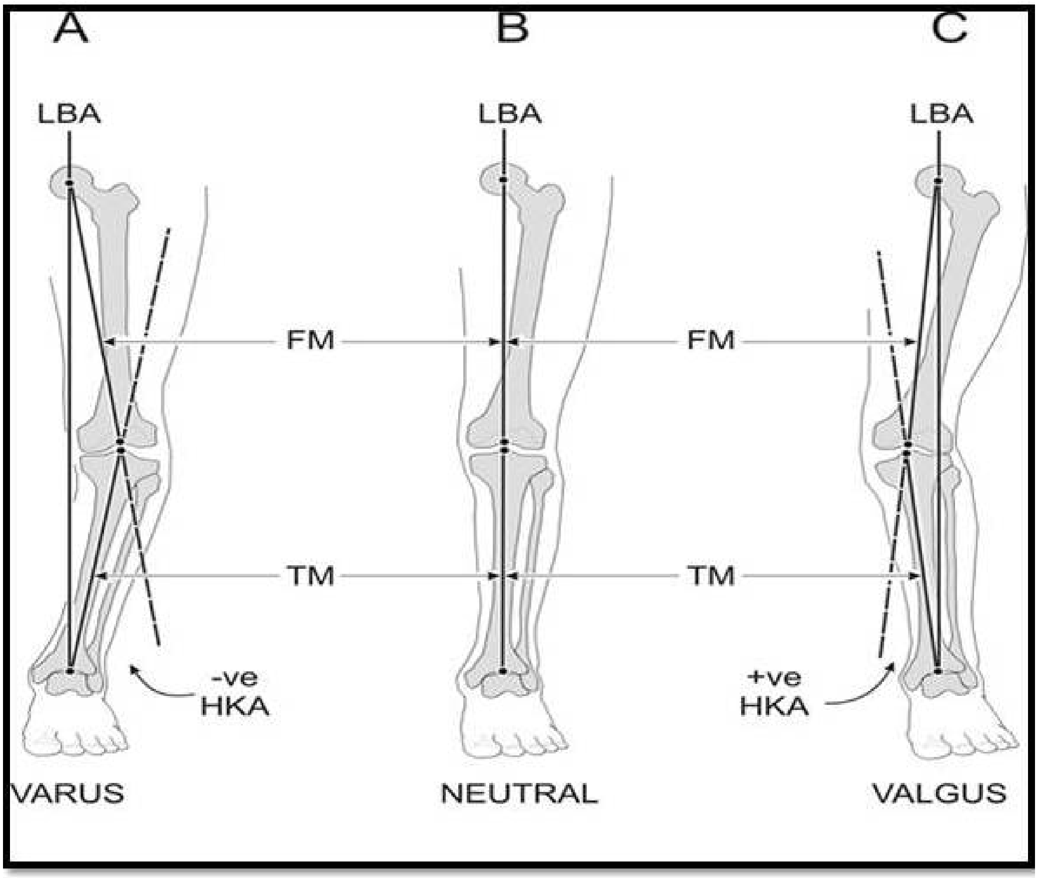


Fig.24. Axial alignment of Knee Joint in Varus and Valgus position

By determining the tibial mechanical axis using the center of the tibial plateau and the femoral mechanical axis using the center of the intercondylar notch, any medial or lateral subluxation through the knee joint is disregarded.

According to Insall, the mechanical axis of the femur is affected by the rotation and lead to lessening the value of these preoperative measurements.

Normally, the tibial articular surface is aligned in 3 degrees of varus and the femoral articular surface is aligned in 9 degrees of valgus with respect to their mechanical axis. Morris, Denham, and others, have shown that implantation of the tibial tray with more than 5 degree of varus leads to failure of the implant by subsiding into more varus.

The tibial tray was inserted perpendicular to the tibial mechanical axis and with varying degree of posterior tilt, which depends upon designs used. The neutral mechanical axis can be achieved by fixing the femoral component in 5 to 6 degree of valgus.

Rotational alignment of femoral and tibial component is determined based on intraoperative measurements. The rotational alignment of the femoral component helps to balance the flexion space and patellofemoral tracking. The symmetrical flexion and extension gap can be achieved by making the tibial cut and the femoral cut perpendicular to their mechanical axis.

Normally the femoral component is implanted in 3 degree of external rotation in relation to the posterior condylar axis with equal tension on the medial and lateral collateral ligaments to create a rectangular flexion space.

The rotational alignment of femoral component can be determined intraoperatively by following techniques

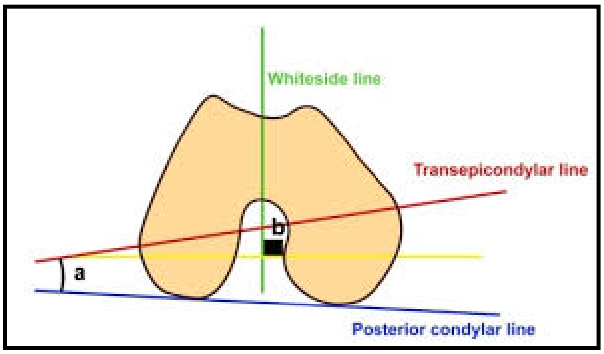
1. Measured resection techniques

   - Transepicondylar axis.

   - Anteroposterior line or Whiteside's line, and

   - Posterior condylar axis.

2. Balanced gap technique.



In a normal male femur, this technique rotationally places the femoral component with the posterior condylar surfaces parallel to the epicondylar axis. Above mentioned technique could not be used in knees with hypoplastic lateral femoral condyle, severe valgus deformity and with significant wear in the posterior condyle of the native femur.

The varus knee presents with an atrophic medial femoral condyle, especially posterior. This can result in increased external rotation of the femoral component if the posterior condylar axis is used as the only reference point. (Fig.25)

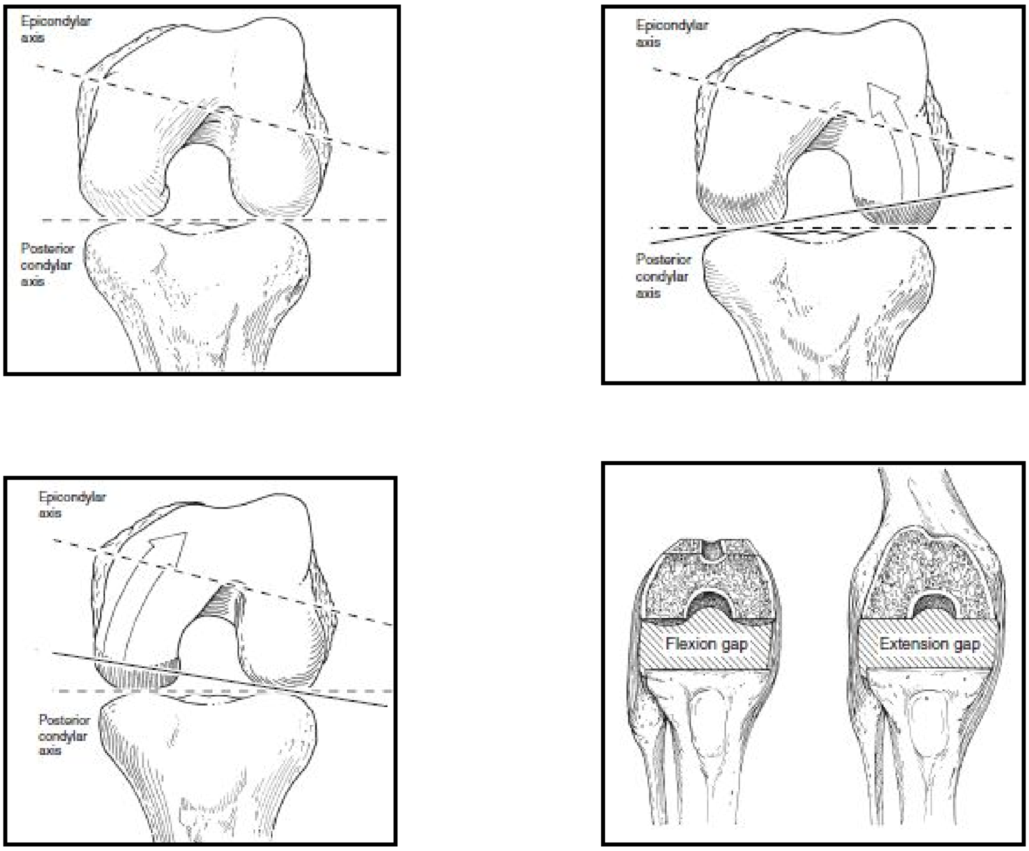


Fig.25.The relationship of the posterior condylar axis and the epicondylar axis in varus and valgus knee.

The valgus knee presents with an atrophic lateral femoral condyle, especially posterior. This can result in increased internal rotation of the femoral component if the posterior condylar axis is used as only reference point. (Fig.25)

In these circumstances, the femoral component can be aligned based on the whiteside line or the transepicondylar axis. It is difficult to determine the transepicondylar axis in vivo, but can be better studied by the CT scan.

The femoral component is aligned with predetermined three degrees of external rotation with reference to posterior condylar line or parallel to the transepicondylar axis, which produces a balanced rectangular flexion space. (Fig.25)

The internal rotation of the femoral component will produce trapezoidal flexion space, which leads to tight medial structures and laxity on the lateral side. Each technique used to determine the rotational alignment of the femoral component intraoperatively, depends on the anatomy of the distal femur.

Knowledge of each of these techniques is necessary because arthritic deformity or previous surgery may obscure one or more of these landmarks. In revision TKA, the epicondylar axis usually is the only native landmark left to ensure proper femoral component rotation.

The rotational alignment of the tibial component is determined by two methods. In the first method, the center of the tibial tray is aligned at the junction of medial one third and lateral two third of the tibial tubercle. In the second method, the movement of the knees is analyzed with trial component in place thus allowing the tibia to align with the flexion axis of the femur. It is essential to produce a normal posterior slope in the tibia. Depending upon the systems the posterior tibial slope may be incorporated in the tibial cut or the slope is built in the polyethylene insert.

Berger et al and Barrack et al stated that the chance of rotational mismatch can be reduced by allowing tibial component to align rotationally with the rotation of the femoral component, thus decreasing the incidence of polyethylene wear, pain and maltracking.[41-42]

Pagnano et al stated that the knee designs with rotating platform in the tibial tray can allow the self-correction of minor malrotation of the tibial tray and improve the congruency of the tibiofemoral articulation but the patella tracking is not improved. [43]

PATELLOFEMORAL TRACKING

Patellofemoral tracking is influenced by various factors, each of these factors should be considered before trial reduction and component implantation. Any factor increases the Q angle of the extensor mechanism can cause lateral maltracking of the patella. Internal rotation of femoral and tibial component can causes patellar maltracking because of increase in the Q angle due to the lateralization the tibial tubercle and by moving the trochlea more medially.

During patellar resurfacing, it is important to medialize the prosthetic patella rather than simply centering the prosthetic button on the available bone. Centralization of the patellar component requires the bony patella to track more medial, which forces it to function with a higher Q-angle. Increasing the anterior displacement of the patella during knee motion also can lead to patella instability or limited flexion. Anterior displacement can be caused by placing the trochlea too far anterior with an over sized femoral component or by under resection of the patella before resurfacing, which results in an overall increase in patellar thickness after resurfacing.

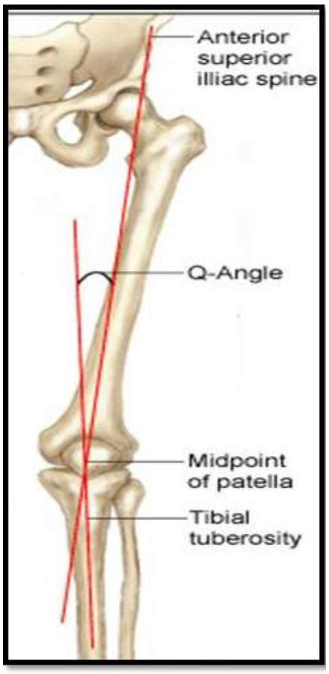


Fig.26. Q - Angle

THE INDICATIONS AND CONTRAINDICATIONS OF TOTAL KNEE ARTHROPLASTY

The primary indication for Total Knee Arthroplasty is the pain due to severe arthritis, with or without associated deformities in the knee. Before planning for total knee arthroplasty in arthritis knee, it is essential to rule out other sources of the knee pain. Patients without significant cartilage loss before the surgery found to have less satisfactory outcome after the arthroplasty.

Before considering arthroplasty in arthritis knee, conservative managements like anti inflammatory medications, activity modifications and physiotherapy should be tried.

The functional outcome and life of prosthesis is significantly affected by the activity level of the patient. Hence it is indicated in older patients with sedentary lifestyles but it is also indicated in younger patients with significant functional limitation due to

1. Systemic arthritis with multiple joint involvements.
2. Post traumatic arthritis.

The Scandinavian knee arthroplasty registers show significantly higher revision rates in younger patients (Robertsson et al. 2001, Furnes et al. 2002). When comparing 1,434 patients aged below 60 years with

21,761 patients aged 60 years or more Harrysson et al. (2004) found a more than twice as high revision rate in the younger patient group. Analyzing loosening of components as the cause of revision, the rate was 6 % for the younger group and 2.5 % for the elder group.

The other indication for Total Knee Arthroplasty includes

1. Osteonecrosis with subchondral collapse of a femoral condyle.
2. Severe pain from chondrocalcinosis and pseudogout in an elderly patient with complete cartilage space loss.
3. Severe patellofemoral arthritis.
4. Severe deformity in the knee with moderate arthritis.

Patients with fixed flexion contractures of more than 20 degree with hampered gait may be an indication for arthroplasty to regain the extension. Similarly if the knees with severe valgus and varus laxity are treated before particular stage of laxity, prosthesis that lacks coronal plane constraint can give better results than constrained condylar type of prosthesis.

CONTRAINDICATIONS TO TOTAL KNEE ARTHROPLASTY

1. Absolute contraindications.

2. Relative contraindications.

Absolute contraindication:

1. Recent or current knee sepsis

2. Remote source of ongoing infection.

3. Extensor mechanism discontinuity or severe dysfunction

4. Recurvatum deformity secondary to muscular weakness.

5. The presence of a painless, well-functioning knee arthrodesis.

Relative contraindications:

1. Any medical conditions that compromise the metabolic demands of surgery, wound healing and anesthetic fitness.
2. Significant atherosclerotic disease of the operative leg.
3. Skin conditions such as psoriasis within the operative field, venous stasis disease with recurrent cellulitis.
4. Neuropathic arthropathy.
5. Morbid obesity.
6. Recurrent urinary tract infections, and
7. History of osteomyelitis in the proximity of the knee.

Any co morbidity that prevents the patient from early mobilization post operatively was considered as relative contraindication.

COMPLICATIONS

THROMBOEMBOLISM

It was the potential life threatening complication following total knee arthroplasty. The prevalence of deep vein thrombosis following total knee arthroplasty without any prophylaxis was 40% to 84%.

The risk factors are age older than 40 years, estrogen use, stroke, nephrotic syndrome, cancer, prolonged immobility, previous thromboembolism, congestive cardiac failure, indwelling femoral vein catheter, inflammatory bowel disease, obesity, varicose veins, smoking, hypertension, diabetes mellitus, and myocardial infarction.

It can be diagnosed by

1. Venography.
2. Duplex ultrasound.

Methods of Deep Vein Thrombosis prophylaxis

1. Compression stockings or foot pumps.
2. Low-dose warfarin,
3. Low-molecular-weight heparin,
4. Fondaparinux (a factor Xa inhibitor), and
5. Aspirin.

In current practice of DVT prophylaxis, low-molecular-weight heparin or warfarin or both was given until the international normalized ratio becomes therapeutic. Prophylaxis was given for atleast 14 days in patients without DVT and 6 weeks in patients with previous episode of DVT.

INFECTION

Infection is one of the devastating complications following Total Knee Arthroplasty. Factors associated with high rate of infection are rheumatoid arthritis (especially in seropositive men), skin ulceration, previous knee surgery, use of a hinged-knee prosthesis, obesity, concomitant urinary tract infection, steroid use, renal failure, diabetes mellitus, poor nutrition, malignancy, and psoriasis.

The most common organisms causing post operative infection are Staphylococcus aureus, Staphylococcus epidermidis, and Streptococcus species.

The diagnosis of infection should be made upon careful history and clinical examination. The timing of infection had significant effect on the outcome of patient.

Aspiration of the joint remains standard for diagnosing the infection with the sensitivity of 45% to 100%. Mason et al suggested that the cell count of the aspirated material will be indicative of probable infection.

The treatment options available are

1. Antibiotic suppression.
2. Debridement with prosthesis retention.
3. Resection arthroplasty.
4. Knee arthrodesis.
5. One-stage or two-stage re-implantation and
6. Amputation.

Factors that lead to high success rate after debridement are

1. Infectious disease consultation and antibiotic monitoring.
2. Diagnosis and treatment of hematogenous infection.
3. Newer antibiotics.
4. Post operative antibiotics for six weeks.
5. Repeat cultures after initial debridement and repeat debridement if the cultures are positive.
6. Polyethylene exchange at the time of debridement exchange of gown, gloves, and instruments; and redraping at the time of wound closure.

PATELLOFEMORAL COMPLICATIONS

It includes

1. Patellofemoral instability.
2. Patellar fracture.
3. Patellar component failure.
4. Patellar component loosening.
5. Patellar clunk syndrome, and
6. Rupture of extensor mechanism.

Patellofemoral instability was due to laxity of medial structures or tight lateral retinaculum. Any factors that increase the Q angle lead to lateral subluxation of patella. The intraoperative rotational malalignment of the femoral and tibial component particularly internal rotation of the components increases the Q angle.

Patellar clunk syndrome was due to formation of fibrous nodule on the undersurface of the quadriceps tendon, which becomes entrapped in the intercondylar notch of femoral prosthesis and cause knee to clunk. It can be treated by arthroscopic debridement of the nodule.

The incidence of rupture of patellar tendon or quadriceps tendon after total knee arthroplasty is 0.1% to 0.55%.

NEUROVASCULAR COMPLICATIONS

Arterial injury in Total Knee Arthroplasty occurs in 0.03% to 0.2% of patients. Several authors recommended not using tourniquet in patients with significant vascular disease.

Most commonly reported nerve injury after Total Knee Arthroplasty is peroneal nerve injury with prevalence of 1.8%.

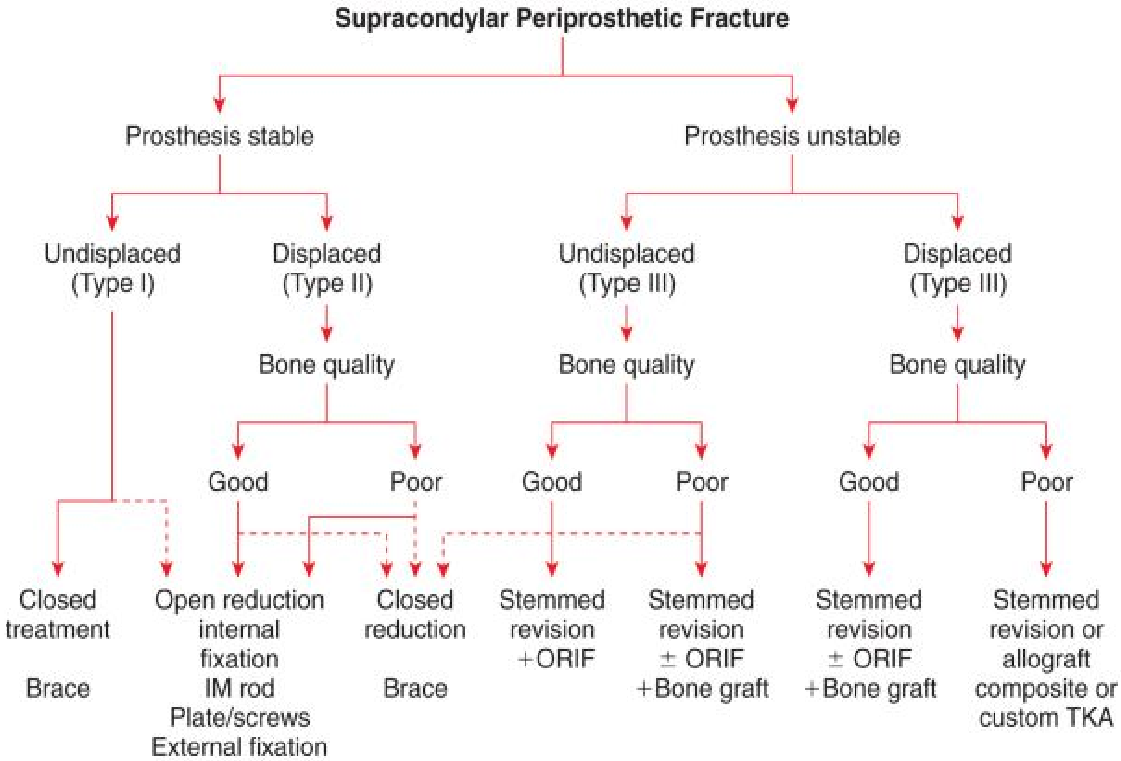
Krackow et al. reported decompression of the peroneal nerve 5 to 45 months after TKA, with complete recovery in four of five patients.

PERIPROSTHETIC FRACTURES

The incidence of supracondylar fracture after Total Knee Arthroplasty was 0.3% to 2%. Risk factors are

1. Notching of anterior femoral cortex.
2. Rheumatoid arthritis.
3. Steroid use.
4. Female gender.
5. Revision arthroplasty, and
6. Neurological disorders.

Treatment algorithm for supracondylar periprosthetic fractures



MATERIALS AND METHODS

Our study is a prospective study of 20 cases of arthritis of knee joints in 20 persons treated with Cemented Total Knee Arthroplasty. This was conducted from June 2011 to November 2013 in Department Of Orthopaedics and Traumatology, Government Mohan Kumaramangalam Medical College, Salem.

INCLUSION CRITERIA

Our patients were selected based upon following criteria

1. Age 40 to 70 years.
2. Patients with Grade III and IV osteoarthritis.
3. Rheumatoid Arthritis.
4. Post Traumatic Arthritis.

EXCLUSION CRITERIA

1. Patients with Grade I and II osteoarthritis.
2. Post septic arthritis sequelae.
3. Any co-morbidity that prevents the patient from early mobilization.

PREOPERATIVE EVALUVATION

All our patients were evaluated with detailed history and clinical examination. The preoperative medical evaluation was done for all to prevent complications. Perioperative guidelines have not been well-established for the use of DMARDs in rheumatoid arthritis.

The current British Society for Rheumatology guidelines suggest that TNF-α inhibitor therapy should be withheld for 2 to 4 weeks prior to any major surgical procedure. Prospective randomized controlled trial by Grennan et al suggested that there was no increased risk of infection or other postoperative complications in patients with rheumatoid arthritis who continued MTX. However, in elderly frail patients with comorbidities and a degree of renal impairment, it may be prudent to withhold MTX the week prior to surgery as MTX is renally excreted.

In the clinical examination, we looked for varus, valgus and fixed flexion deformities. The extensor mechanism was assessed for any quadriceps contracture. We also assessed for any ligmentous instability and laxity. Any limb length discrepancies were noted. The knee function was assessed preoperatively by using knee society score.

Routine preoperative laboratory evaluations including complete blood cell count, electrolytes, urine analysis, blood grouping, ECG, chest roentgenogram and coagulation studies were done.

We obtained opinions from otorhinolaryngology, dermatology, dental surgery, and carried out appropriate investigations to rule out the septic foci elsewhere in the body.

RADIOLOGICAL EVALUVATION

Standard guidelines were utilized to get knee radiographs – weight bearing anteroposterior view, lateral view. The patellar tracking was assessed with tangential patellar view. The mechanical axis and the alignments of both lower limbs were studied by taking the X-rays including the hip, knee and ankle.

Angle between mechanical axis of femur and tibia determines the valgus or varus deformity. Any collateral ligament laxity, subluxation of tibia, presence of osteophytes, any bone defects and the quality of bone is assessed. Sizing of the femoral and tibial components was done.

The goal of preoperative radiological evaluation is to

1. Confirm the diagnosis for surgical intervention,
2. To determine the anatomical relationship of the femur and tibia, and
3. To restore the joint anatomy and biomechanics.

SURGICAL PROCEDURE

POSITION

The patient is placed in supine position on the operating table. Two stoppers were kept on the operating table with one in 30^0 of knee flexion and another one at full available flexion.

With strict aseptic precautions, painting and draping of the lower limb was done. Pre operative antibiotics were given just before the skin incision. All cases were done under tourniquet control.

APPROACH

We used anterior midline approach for the skin. 10 cm incision was made centering the patella and extending up to the tibial tuberosity. Medial parapatellar arthrotomy was done to expose the knee joint. The advantage of using the medial parapatellar approach was to prevent the fibrosis on the lateral retinaculum, which may predispose to the dislocation of the patella. Post operative arthrofibrosis can be prevented by excising the retropatellar fat pad.

The knee is extended and the patella is everted along with the release of the lateral patellofemoral plica. The anterior cruciate ligament was divided along with the anterior horn of the lateral meniscus to facilitate the eversion of the patella.

In knees with varus deformity there is sequential release of superficial collateral ligament, deep collateral ligament, pes tendons and semimembranous muscle from the posteromedial corner of tibia. (Fig.27)

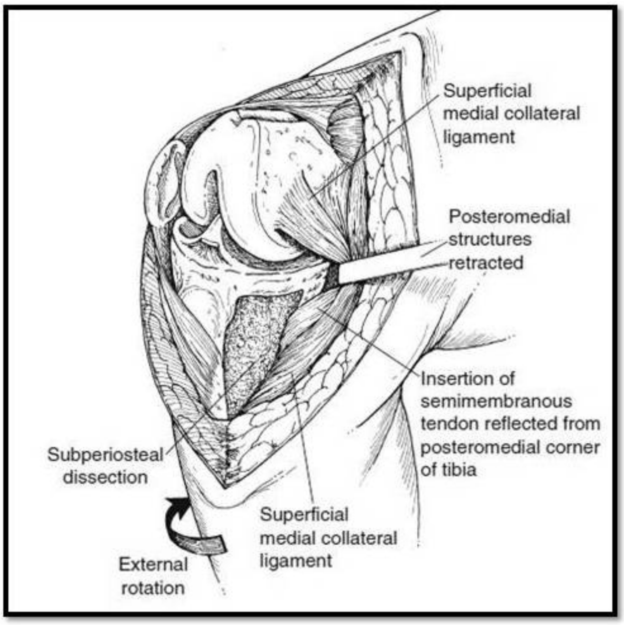


Fig.27.Sequential release to correct the varus deformity.

In knees with valgus deformity, lateral release begins with transverse cutting of the posterolateral structures (arcuate ligament, posterolateral capsule and reinforcing ligaments) just below the popliteus tendon from the posterolateral corner of the cut surface of the tibia. In severe cases piecrust" release of the iliotibial tract and LCL is performed with a 15 blade by making multiple horizontal incisions in the iliotibial tract. (Fig.27)

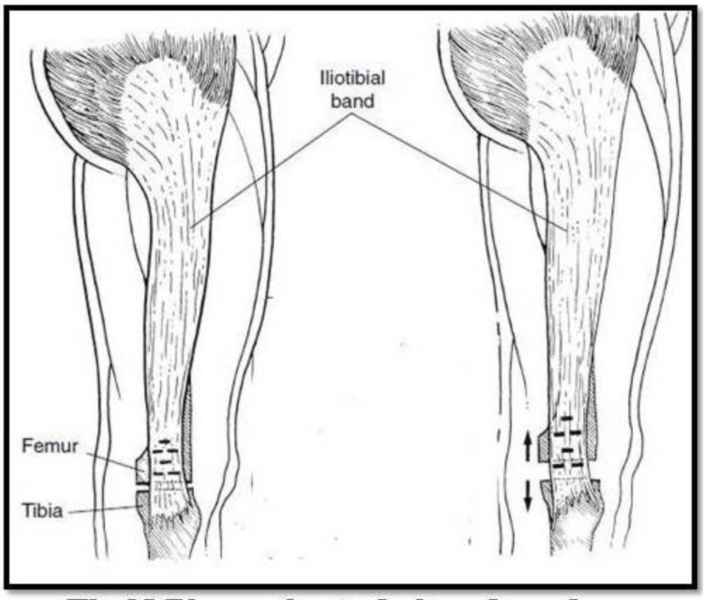


Fig.28.Piecrusting technique for valgus deformity.

The knee is again flexed, the marginal osteophytes removed completely along with the removal of anterior horns of both medial and lateral meniscus. The tibia can now be subluxated anteriorly and externally rotated. The patellar fat pad is partially excised and the everted extensor mechanism is retracted with a levering-type of retractor to expose the lateral tibial plateau.

FEMORAL PREPARATION

Femoral preparation is done using intramedullary alignment jig. The Whiteside line and Trans-epicondylar line was made over the femoral condyles after exposing the condyles. The vertical line cutting through the middle of distal femoral sulcus is the whiteside line. The horizontal line linking the medial and lateral epicondyle is the Trans-epicondylar line. At the intersection between these two lines, the starter hole was created. With the help of 9.5mm diameter drill bit, medullary canal was opened.

Intramedullary jig was introduced in to the femur along with the valgus alignment guide with the predetermined external rotation of three degrees. The distal resection guide was assembled and standard resection was done, which provides a 9mm distal femoral cut. The distal femoral cut should be perpendicular to the mechanical axis of the femur. After ensuring that the resection block is flushed against the femur, anterior and posterior chamfer cuts were made. We have used both cruciate retaining and cruciate substituting prosthesis. For cruciate substituting prosthesis intercondylar box cut was made to accommodate the post and cam mechanism.

TIBIAL PREPARATION

The extramedullary tibial guide was assembled composing of the cross head with pin, resection guide and ankle yoke. The tibial guide fixed in such a way, which provides the tibial cut perpendicular to the mechanical axis with slight posterior angulation. The resection slot is attached proximally and flushed to the tibial condyle just below the articular surface. The stylus was used to check the tibial cut, with 2mm on the defective side or 10mm on the normal side as a reference. The tibial cut was completed by using the osteotome to prevent the popliteal artery injury.

LIGAMENTOUS BALANCING

The flexion and extension gaps are checked by using the spacer blocks. The varus and valgus instability was corrected with medial and lateral release. The osteophytes that tent the collateral ligaments and the capsule were removed completely. The flexion and extension gaps should be rectangular and equal.

The tight extension gap can limit the extension, which can be corrected by removing the excess bone from the distal femoral cut or by the release of the posterior capsule. Similarly, the tight flexion gap can limit the post operative flexion, which can be corrected by removing the excess bone from the posterior condyle of the femur. In cases where the flexion and extension gaps are equal but the space is not enough for the prosthesis, the excess bone is removed from the tibia. Since, the tibial cut affects the flexion and extension gaps equally.

The limb alignment was checked by using the alignment rod. Normally it should pass through the handle from the second toe to the anterior superior iliac spine. The tibial trial base was placed at medial one third of tibial tuberosity and the size was confirmed, care should be taken to avoid the medial overhanging. The entry hole for the tibial stem is marked and drilled with the oversize reamer. The tibial punch is designed to engage its rim with the tibial trial base and has the marking to indicate the depth to which it should be impacted. After satisfactory reduction, the patella was denervated circumferentially using the electrocautry.

COMPONENT IMPLANTATION

The trial prosthesis for tibia and femur is fixed with the articular insert, the ligamentous balancing and patellar tracking was assessed. The trial components are removed and bony ends were cleaned with saline. The tibial tray is implanted first with the bone cement. Excess cement is removed from the periphery of the component.

The femoral component is cemented in a similar fashion with a few additional considerations. Usually, all components are cemented simultaneously with one batch (40 g) of cement. The press fit articular insert was fixed to the tibial tray.

Tourniquet was released. Complete hemostasis achieved. Wound wash was given. Wound closed in layers with the knee in 30 to 40 degrees of flexion with suction drain. Sterile dressing was done. The average tourniquet time was 1 hr and 50 minutes with the average blood loss of 180ml.

POST OPERATIVE PROTOCOL

In the immediate post operative period compression bandage was applied. Intravenous antibiotics were given for 48 to 72 hrs. Epidural analgesia is continued for 48 hrs post operatively. Subcutaneous low molecular weight heparin was given as DVT prophylaxis.

On day of surgery, patient was started on CPM in the recovery room for at least 4 hours. A towel roll is placed under the ankle once the CPM is stopped.

1st Post op day, Increase the CPM by 10^0, Static quadriceps strengthening exercise were taught, Patient was ambulated using standard walker with toe touch walking.

2nd Post operative day, the dressing along with drainage tube was removed and wound inspected. Continuous Passive Motion was continued and full weight bearing was allowed with walker.

4thpost op day, patient was taught dynamic quadriceps exercises and active knee flexion up to 90^0.

Patient continues supervised physiotherapy till discharge and sutures were removed on 12th post operative day.

Patient were advised to increase the active knee flexion to attain full range of knee movement by the end of 6 weeks and allowed climb stairs by the end of one month.

FOLLOW UP

Patients were followed up with post operative CT scan to assess the rotational alignment of the femoral component using the transepicondylar axis and posterior condylar line of the femoral component and followed up clinically and functionally at 3 months, 6 months and 1 year using the Knee Society Score.

Patients were analyzed with 3mm CT (Siemens Somatom volume zoom, 4 slice detector) at 2 weeks of follow up. CT images were obtained in a leg holder to minimize the motion of lower extremity. The scan direction was aligned at 90° to the tibial axis. A slice in which both lateral and medial epicondyles were clearly visualized was chosen for measurements.

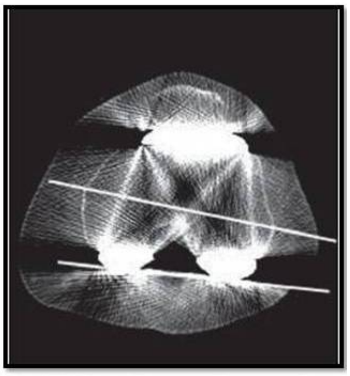


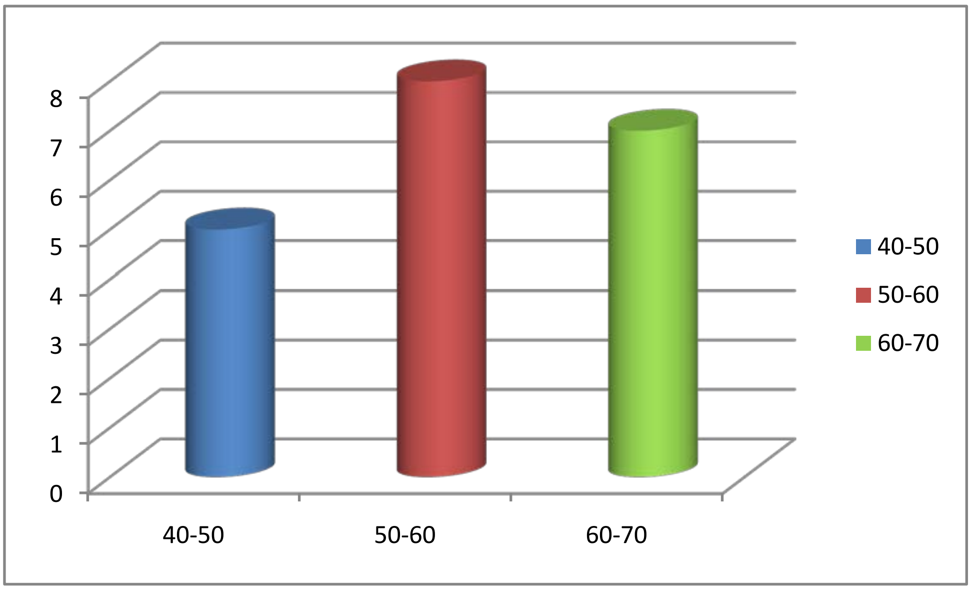
Fig.29.Rotational alignment of femoral component in 2D-CT.

OBSERVATION AND RESULTS

AGE DISTRIBUTION

Our patient age ranges from 40 to 70 years with an average of 57 years. Most of our patients were between 50 to 70 years

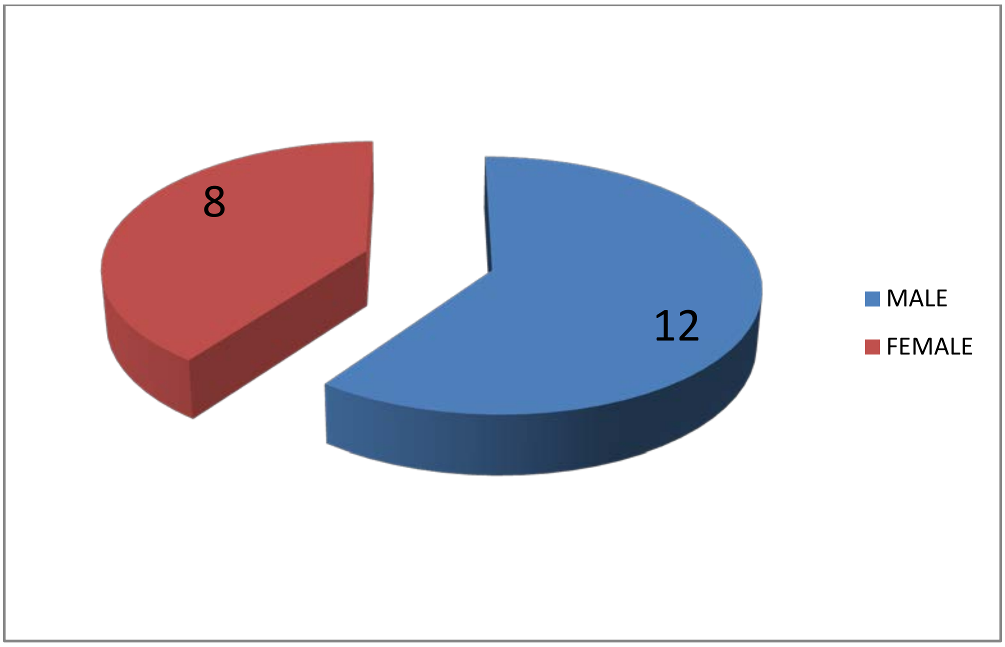
AGE	NO OF PATIENTS
40 – 50	5
51 – 60	8
61 -70	7



SEX DISTRIBUTION

Male preponderance was noticed in our series with male to female ratio of 3:2.

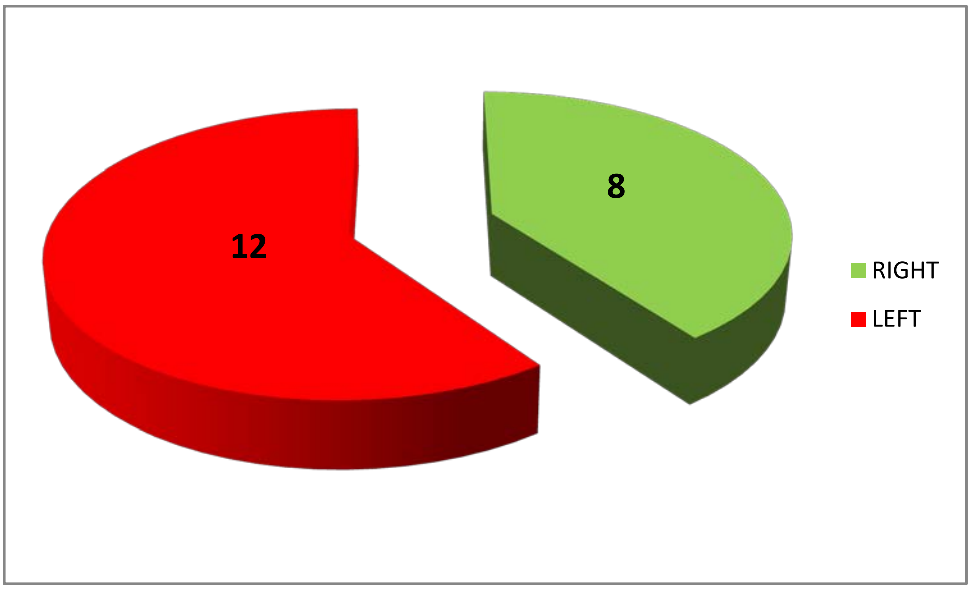
SEX	NO OF PATIENTS
MALE	12
FEMALE	8



SIDE DISTRIBUTION

Our series left side is more commonly involved than right side.

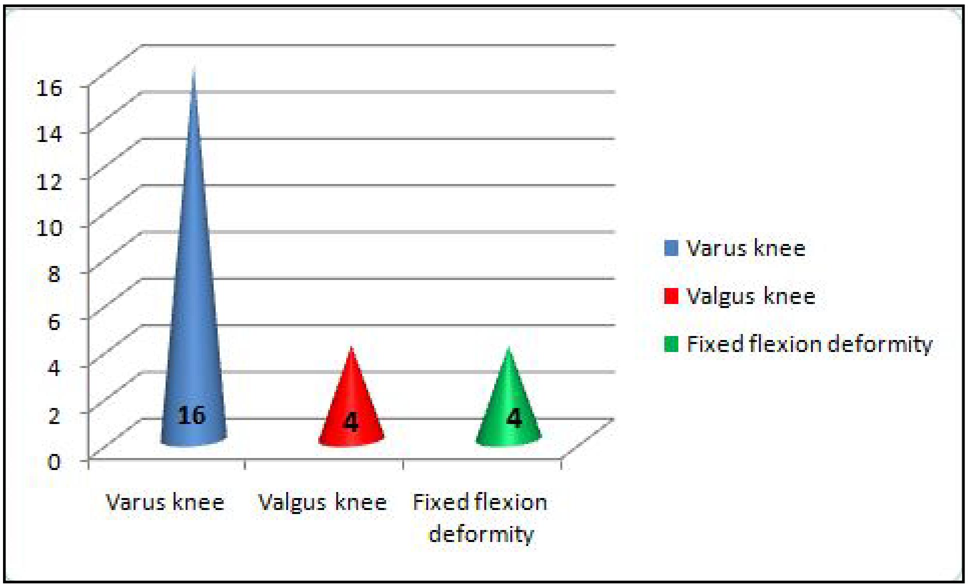
SIDE	FREQUENCY
RIGHT	8(40%)
LEFT	12(60%)
TOTAL	20(100%)



DEFORMITY

In our study 80% of cases had varus deformity, 20% had valgus deformity and 20% had fixed flexion deformity.

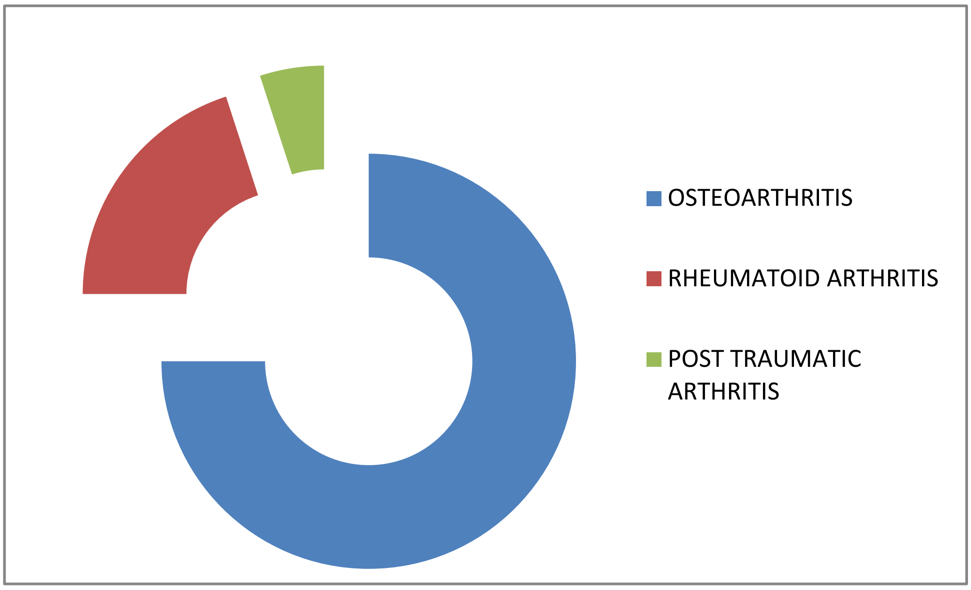
DEFORMITY	FREQUENCY
VARUS KNEE	16(80%)
VALGUS KNEE	4(20%)
FIXED FLEXION DEFORMITY	4(20%)



INDICATIONS

Osteoarthritis was the most common indication in our series followed by Rheumatoid arthritis and post traumatic arthritis.

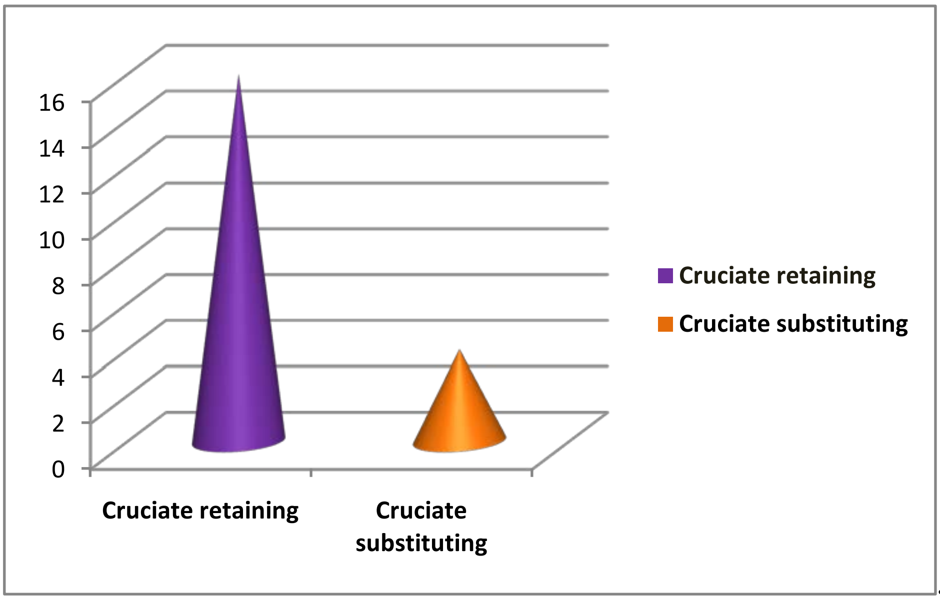
INDICATION	NO OF PATIENTS	PERCENTAGE OF PATIENTS
OSTEOARTHRITIS	15	75
RHEUMATIOD ARTHRITIS	4	20
POST TRAUMATIC ARTHRITIS	1	5



TYPE OF PROSTHESIS

Cruciate retaining prosthesis were more commonly than cruciate substituting prosthesis.

TYPE OF PROSTHESIS	NO OF PATIENTS	PERCENTAGE OF PATIENTS
CRUCIATE RETAINING	16	80
CRUCIATE SUBSTITUTING	4	20



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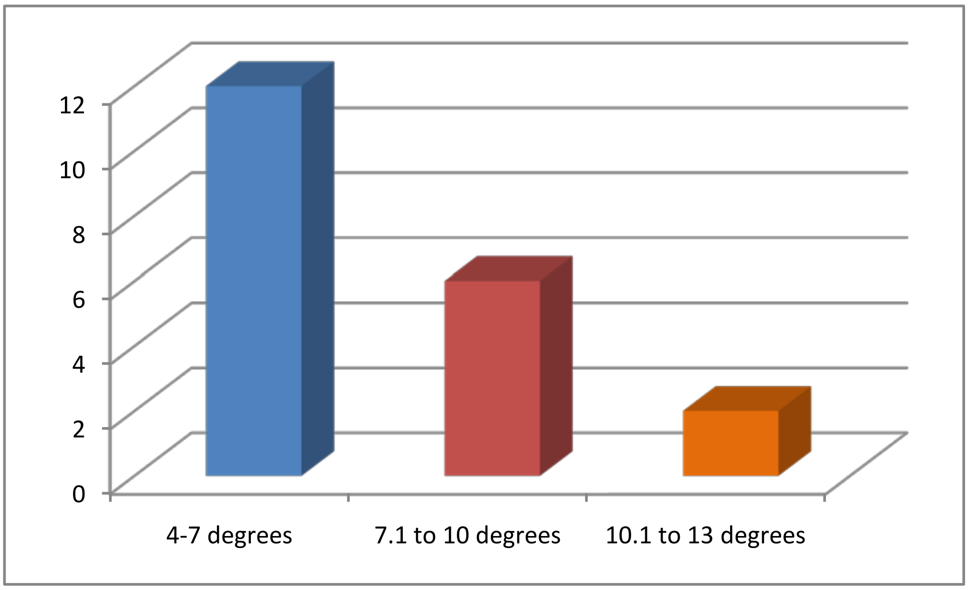
ROTATIONAL ALIGNMENT OF THE FEMORAL COMPONENT

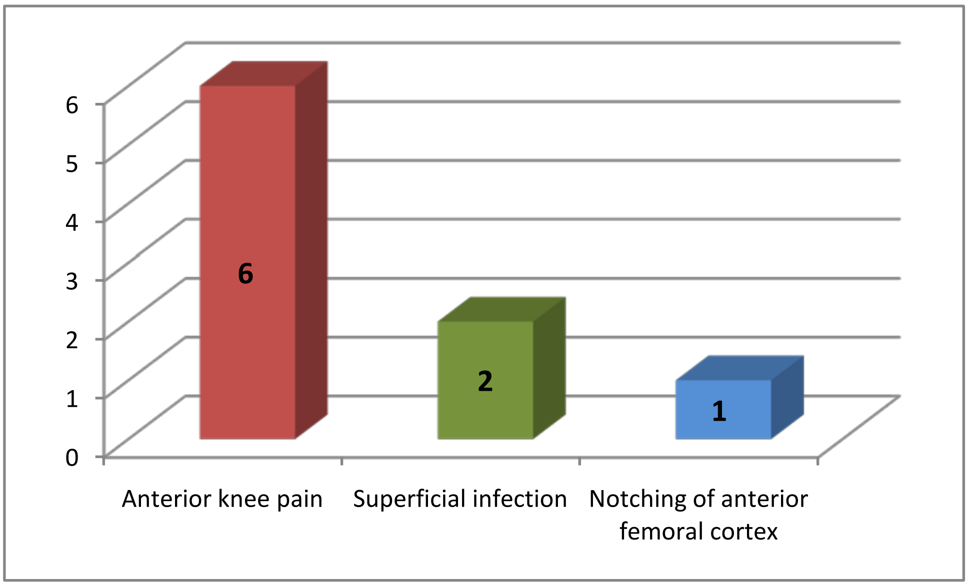
ROTATIONAL ALIGNMENT OF THE FEMORAL COMPONENT IN EXTERNAL ROTATION	FREQUENCY	PERCENTAGE OF PATIENTS
4 -7 degrees	12	60
7.1 -10 degrees	6	30
10.1 -13degrees	2	10



COMPLICATIONS

In our study anterior knee was seen in 30 % of cases, superficial infection in 10 % of cases and notching of anterior femoral cortex in 5 % of cases.

COMPLICATIONS	FREQUENCY	PERCENTAGE OF PATIENTS
Anterior knee pain	6	30
Superficial infection	2	10
Notching of anterior femoral cortex	1	5



KNEE CLINICAL SCORE

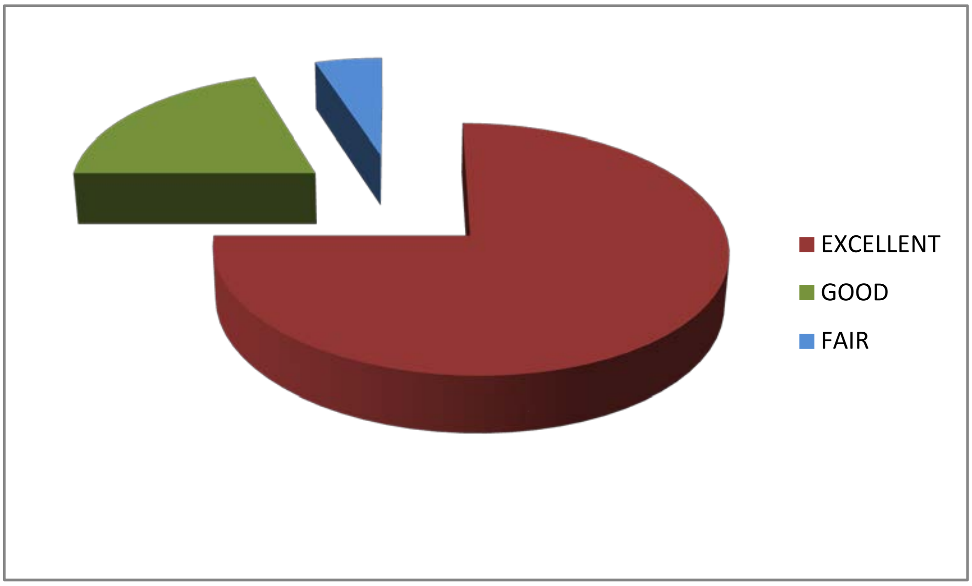
	N	MEAN	MEDIAN	MODE	STANDARD DEVIATION	MINIMUM	MAXIMUM
Pre-op	**20**	27.15	28	28	7.45	14	38
Post-op	**20**	91.6	92	98	7.34	75	99

The average pre operative Knee Clinical Score was 27.15 in this study, which improved to an average post op score of 91.6.

Grading of knee clinical score

According to the Knee Society Clinical scoring system out of 20 patients, 15 patients (75%) had excellent results, 5 patients (20%) had good results and 1patient (5%) had fair results.

	FREQUENCY	PERCENT
EXCELLENT	15	75
GOOD	4	20
FAIR	1	5
TOTAL	20	100



KNEE FUNCTIONAL SCORE

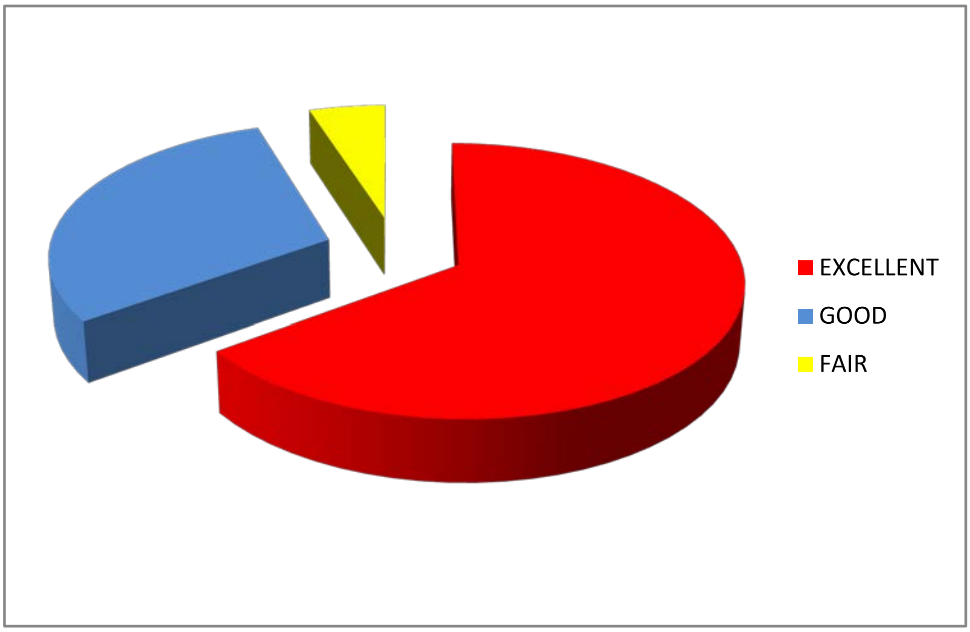
	N	MEAN	MEDIAN	MODE	STANDARD DEVIATION	MINIMUM	MAXIMUM
Pre-op	**20**	37.25	45	45	11.5	20	50
Post-op	**20**	86	90	90	5.98	70	90

The average pre operative Knee Functional Score was 37.25 in this study, which improved to an average post op score of 86.

Grading of knee functional score

According to the Knee Society Functional Scoring system out of 20 patients,13 patients (65%) had excellent results, 6 patients (30%) had good results and 1patient (5%) had fair results.

	FREQUENCY	**PERCENT**
EXCELLENT	13	65
GOOD	6	30
FAIR	1	5
TOTAL	20	100



KNEE CLINICAL SCORE AND KNEE FUNCTIONAL SCORE CROSS- TABULATION

	Knee Functional Score				
Knee Clinical Score		Excellent	Good	Fair	Total
Excellent		13	2		15
Good			4		4
Fair				1	1

Out of the 15 patients who had Excellent Knee Clinical Scores, 13 patients (86.5%) had Excellent Knee Functional Scores, 2 patients (13.5%) had Good Knee Functional Scores.

Out of the 4 patients who had good Knee Clinical Scores, 4 patients (100%) had Good Knee Functional Score.

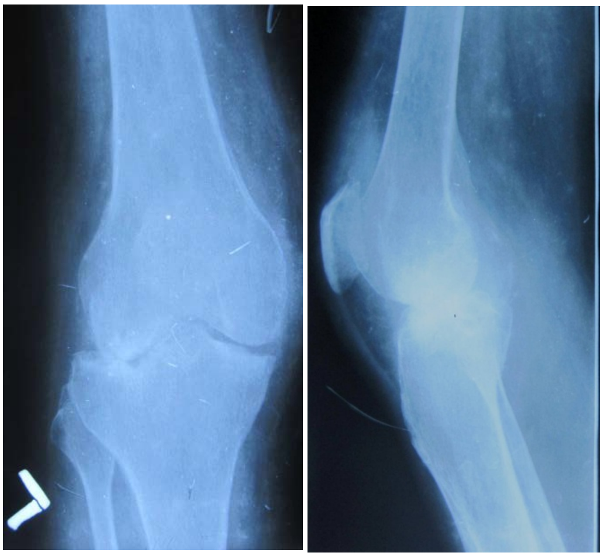
COMPARISON BETWEEN PRE-OP AND POST-OP KNEE CLINICAL AND FUNCTIONAL SCORES

	PAIRED DIFFERENCE		t	df	'P' Value
	MEAN	STANDARD DEVIATION			
Pre –OP KCS – Post OP KCS	64.45	7.31	39.436	19	<0.001
Pre- OP KFS – Post –OP KFS	48.75	11.3	19.224	19	<0.001

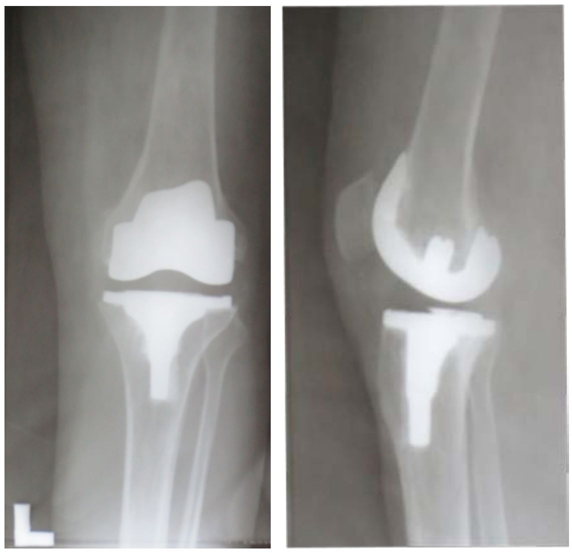
The difference between the mean's of pre – op KCS and post – op KCS was 64.45 (67.87 to 61.03, 95% CI). The P value was significant (<0.001) when the pre – op and post – op Knee Clinical Scores were compared.

The difference between the mean's of pre – op KFS and post – op KFS was 48.75 (54.06 to 43.44, 95%CI). The P value was significant (<0.001) when the pre - op and post – op Knee Functional Scores were compared.

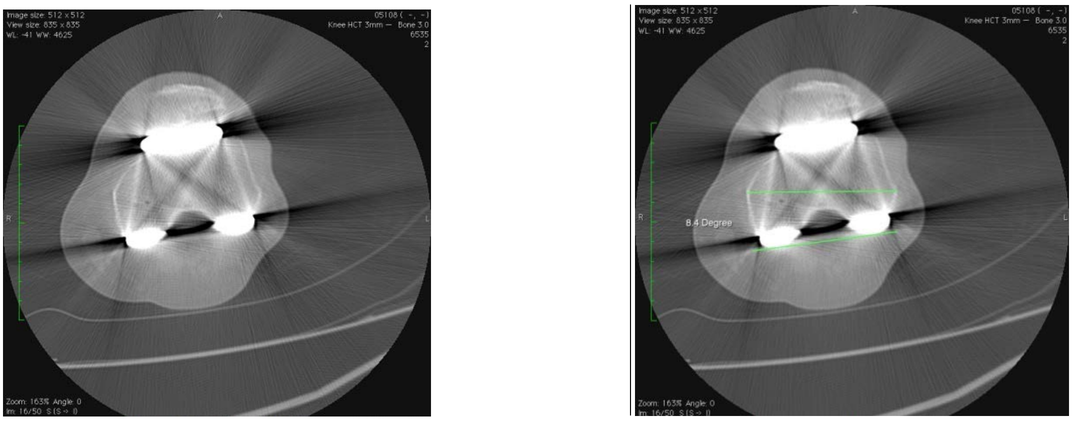
CASE 1



PRE-OP X-RAY



POST OP X-RAY



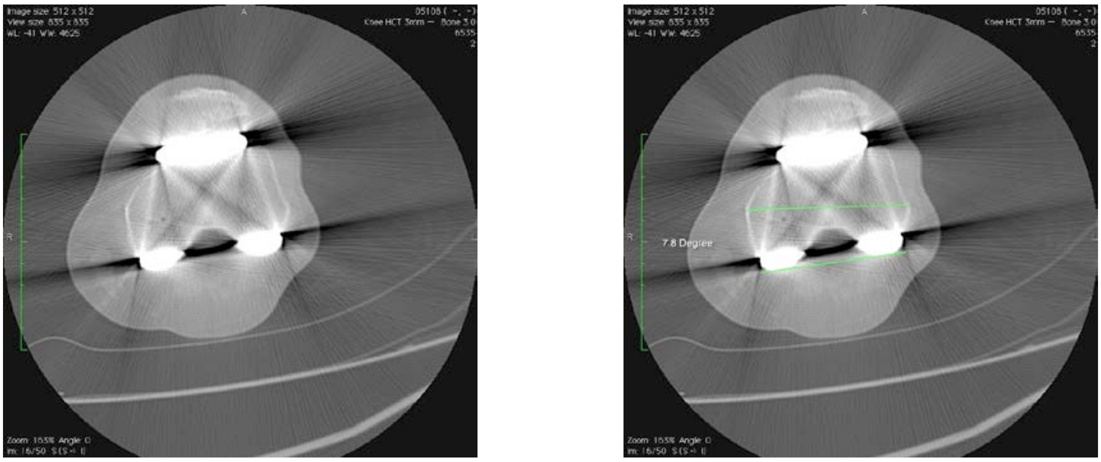
ROTATIONAL ALIGNMENT OF THE FEMORAL COMPONENT

FUNCTIONAL OUTCOME ONE YEAR FOLLOW UP

CASE-2

PRE OP X-RAY

POST OP X-RAY

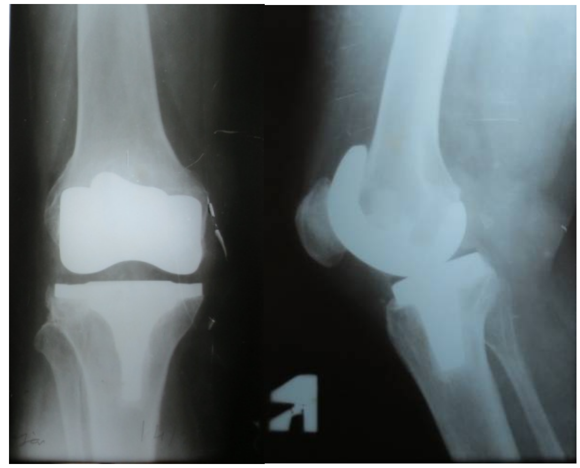


ROTATIONAL ALIGNMENT OF FEMORAL COMPONENT

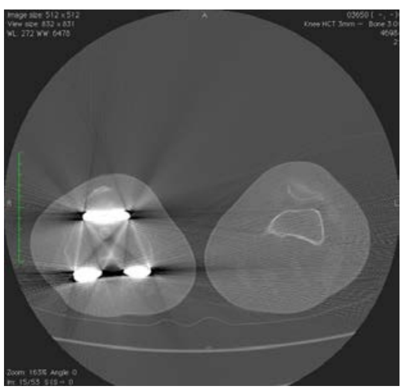
FUNCTIONAL OUTCOMEONE YEAR FOLLOW UP

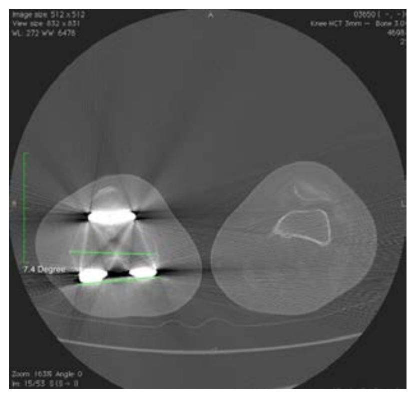
CASE-3

PRE OP X-RAY



POST OP X-RAY





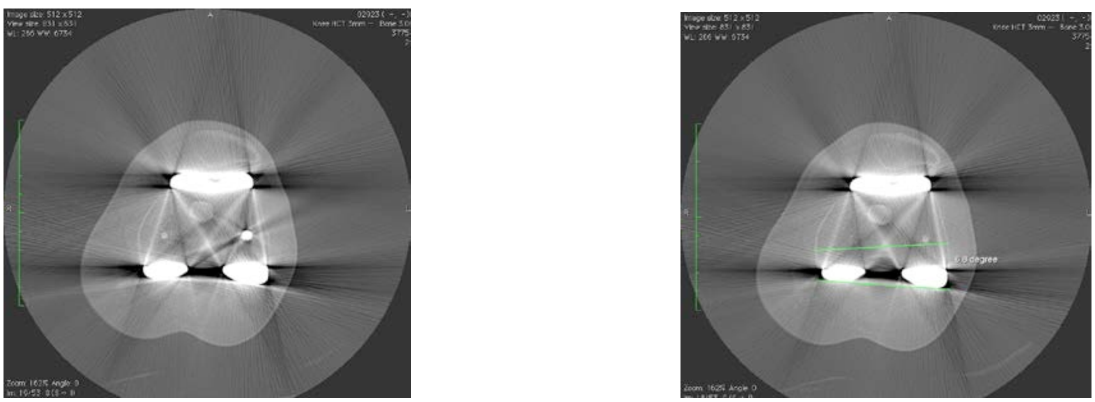
ROTATIONAL ALIGNMENT OF FEMORAL COMPONENT

FUNCTIONAL OUTCOME ONE YEAR FOLLOW UP

CASE-4

PRE OP X-RAY

POST OP X-RAY



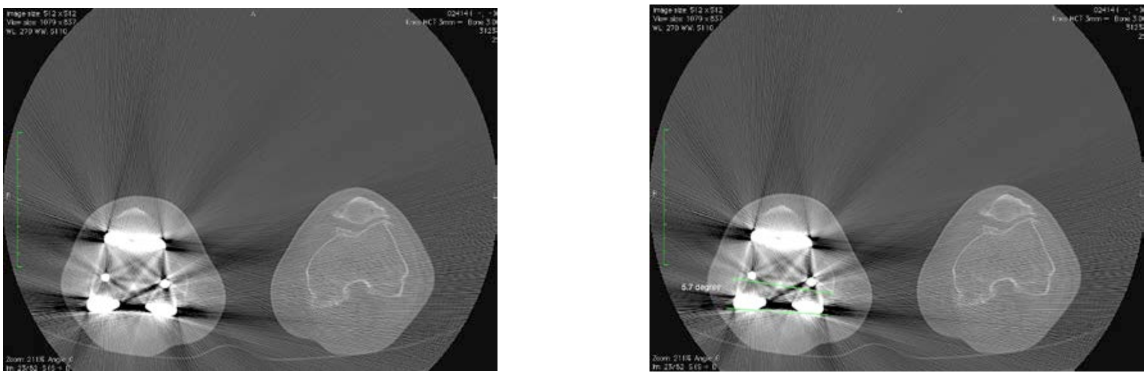
ROTATIONAL ALIGNMENT OF FEMORAL COMPONENT

FUNCTIONAL OUTCOME ONE YEAR FOLLOW UP

CASE-5

PRE OP X-RAY

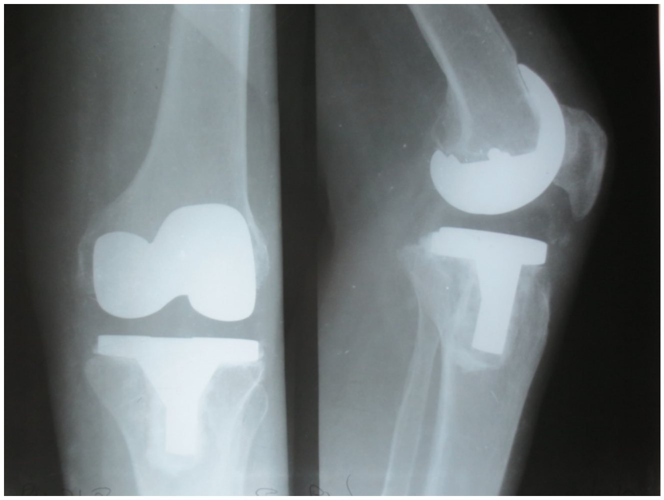
POST OP X-RAY



ROTATIONAL ALIGNMENT OF FEMORAL COMPONENT

FUNCTIONAL OUTCOME ONE YEAR FOLLOW UP

COMPLICATIONS



NOTCHING OF ANTERIOR FEMORAL CORTEX

SUPERFICIAL INFECTION

DISCUSSION

Total Knee Arthroplasty in patients with arthritis knee will significantly improve the functional outcome and quality of life. Osteoarthritis was the most common indication followed by Rheumatoid arthritis and other inflammatory arthritis. Various types of prostheses was available.

The selection of prosthesis for each patient depends on the anatomical status of the knee joint. The functional outcome following Total knee Arthroplasty depends upon various parameters including surgical technique, soft tissue balancing, rotational alignment of the femoral and tibial components, and cementation of the prosthesis.

The rotational alignment of the femoral component plays a critical role in determining the soft tissue balance and tracking of patella.

Robert L Barrack et al. stated that anterior knee pain following the Total knee Arthroplasty depends on component rotation or component design rather than resurfacing of the patella. [44]

Nutton and wood et al stated that the resurfacing of the patella in Total Knee Arthroplasy exhibited poor clinical results when compared to Total Knee Arthroplsty with retention of patella. Patellar resurfacing was associated with significant anterior knee pain.[45,46]

In our study, none of the patella was resurfaced. All patellas were circumferentially denervated.

Rotational malalingment of the femoral component leads to

1. Patellar maltracking.
2. Anterior knee pain.
3. Femoro-tibial flexion instability.
4. Premature wear of the polyethylene.

The incidence of implant loosening was reported to be 3% in knee athroplasty with well aligned components and 24 % in knee arthroplasty with malaligned prosthesis.[47]

In Total Knee Arthroplasty, an internally rotated femoral component not only leads to patellar maltracking, it also produces relative laxity on the lateral side in flexion and tightness on the medial side. Conversely, excessive external rotation of the femoral component leads to the laxity on the medial side with restriction of flexion due to ligament tightness on the lateral side. Hence, the force through the extensor mechanism is altered and leading to abnormal loading of the patella and polyethylene wear.

In our study 20 cases of arthritis knee treated with cemented Total Knee Arthroplasty were studied. The rotational alignment of the femoral component were studied post operatively by **axial two-dimensional (2D) CT scan** after 2 weeks of surgery.

In our study osteoarthritis (75%) is the most common indication followed by Rheumatoid arthritis (20%) and post traumatic arthritis (5%).

In our study we used cruciate retaining prosthesis in 16 cases (80%) and cruciate substituting prosthesis in 4 cases (20%).

In our study, the femoral component is rotationally aligned with reference to the transepicondylar axis. Post operatively the rotational alignment of the femoral component was studied with two dimensional CT scan. It is done by measuring the angle between the transepicondylar line and the posterior condylar line of the prosthesis.

Miller et al stated that shear force across the patellofemoral joint will be minimal when the femoral component is aligned parallel to the transepicondylar axis.[48]

Poilvache et al. reported that the transepicondylar axis was a reliable axis for establishing rotational alignment, but other studies have documented the difficulty of accurately establishing this axis.[49]

In our study out of 20 cases analyzed with post operative scan, the femoral component was aligned in external rotation in all cases with minimum of 4.1 degree to maximum of 11 degree.

Berger et al reported that there was no patellofemoral complication, when the femoral component is aligned between zero degrees (0^{o}) to ten degree (10^{o}) of external rotation.[50] In our study also the femoral component is aligned between 4 degree to 11 degree of external rotation. Hence the chance of patellofemoral will be minimal.

Olcott, Scott and Miller reported that excessive external rotation has been reported to increase the medial flexion gap and that leads to symptomatic flexion instability, and external rotation of the femoral component by as little as 5° from the transepicondylar axis has been reported to increase shear forces on the patellar component.[51,52]

In our study out of 20 cases, anterior knee pain was noted in 6 cases (30%), superficial infection was noted in two cases (10%) and treated with culture sensitive antibiotics.

In our study Tayside grade I notching of anterior femoral cortex was noted in 1case (5%). The patient was advised to review at every 2months to look for increase in notching and periprosthetic fractures.

Ritter et al. 2005 reported that the incidence of notching of anterior femoral cortex following total knee replacement was 30%.[53]In our study the femoral notching was noted in 5% of cases which is superior to studies by Ritter et al.

Hirsh et al. 1981, Aaron and Scott 1987, Culp et al. 1987 reported 0.5% to 52% incidence of supracondylar fracture of the femur in TKR with anterior femoral notching.[54,55]

Zalzal et al. (2006) found that the femoral notching of more than 3mm located at the proximal end of the prosthesis increases the risk of periprosthetic fractures. However, a direct relationship between these events has not been established in the literature.

In our study the post operative functional outcome was assessed by Knee Society Score. The Knee Society Score system is subdivided in to a knee score that relates only the knee score that rates only the knee joint itself and a functional score that rates the patient's ability to walk and climb stairs. This dual rating system eliminates the problem of declining knee scores associated with patient infirmity.[10]

In our study there was significant improvement of Knee Clinical Score and knee Functional Score following Total Knee Arthroplasty.

According to the Knee Society Clinical Scoring System out of 20 patients, 15 patients (75%) had excellent results, 5 patients (20%) had good results and 1patient (5%) had fair results.

According to the Knee Society Functional Scoring System out of 20 patients, 13 patients (65%) had excellent results, 6 patients (30%) had good results and 1patient (5%) had fair results.

CONCLUSION

Total Knee Arthroplasty improves the functional ability of the patient and the ability of the patient to get back to pre-disease state, which is to have a pain free mobile joint, as reflected by the improvement in the post-op Knee Clinical Score and Knee Functional Score.

There was significant association between the Knee Clinical Score and Knee Functional score.

It is possible to achieve the rotational alignment of the components correctly in unnavigated Total Knee Replacement with appropriate surgical techniques, so that the complications due to malalignment of the components can be avoided.

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PROFORMA

Case No:

Name:

I.P.No:

Age:

Sex:

D.O.A.

D.O.D.

Address:

Occupation:

DIAGNOSIS:

I) HISTORY:

Complaints:

Pain

Swelling

Duration

Side

Restriction of activities

Instability

II) PAST HISTORY ;

III) GENERAL PHYSICAL EXAMINATION :

Pallor

B.P.

P.R.

Temp.

IV) LOCAL EXAMINATION :

i) Inspection :

Attitude

Swelling

Deformity

Skin

ii) Palpation :

Local rise of temperature

Tenderness

Deformity

Crepitus

iii) Movements :

iv) Neurovascular status :

v) Associated injuries

vi) Complications (if any)

V) MANAGEMENT:

A) Investigations:

1) Blood: Hb%

TC

DC

Sugar

ESR

2) Urine: Albumin

3) Blood urea:

Blood sugar:

S.creatinine:

4) HIV

HBsAg

5) ECG

6) X-ray clavicle with shoulder AP view

VI) Treatment:

i) Surgical procedure

ii) Indication

iii) Date of surgery

iv) Type of Anaesthesia

v) Implant used

vi) Immobilization after surgery- Duration

viii) Check x- ray :

ix) Rehabilitation :

VII) COMPLICATIONS:

VIII) FOLLOW UP:

CT scan to assess the rotational alignment of femoral component and functional out come by Knee Society Score.

IX) ASSESSMENT OF RESULTS:

The knee score and knee function score are considered separately. Scores between

· 100 & 85 - Excellent

· 84 & 70 - Good

· 69 & 60 – Fair.

Knee Society Scoring System

KNEE CLINICAL SCORE		PRE-OP	POST-OP
PAIN	**SCORE**		
NONE	50		
MILD OR OCCASIONAL	45		
STAIRS ONLY	40		
WALKING AND STAIRS	30		
MODERATE OCCASIONAL			
CONTINUOS	10		
SEVERE	0		
ROM (5^{o}= 1 POINT)			

STABILITY(MAXIMAL MOVEMENT IN ANY POSITION)			
ANTERO- POSTERIOR			
< 5mm	10		
5-10mm	5		
10mm			

MEDIOLATERAL		PRE OP	POST OP
$<5^{o}$	15		
$6\text{-}9^{o}$	10		
$10\text{-}14^{o}$	5		
15^{o}	0		
SUBTOTAL			

DEDUCTIONS(minus)		**PRE-OP**	**POST OP**
FLEXION CONTRACTURE	SCORE		
5-10^{o}	2		
10-15^{o}	5		
16-20^{o}	10		
>20^{o}	15		
EXTENSION LAG			
<10^{o}	5		
10-20^{o}	10		
>20^{o}	15		
ALLIGNMENT			
5-10^{o}	0		
0-4^{o}	3 points each degree		
11-15^{o}	3 points each degree		
Others	20		
TOTAL DEDUCTIONS			
KNEE CLINICAL SCORE			

KNEE FUNCTIONAL SCORE		**PRE-OP**	**POST-OP**
WALKING	SCORE		
UNLIMITED	50		
>10 BLOCKS	40		
5-10 BLOCKS	30		
<5 BLOCKS	20		
HOUSE-BOUND	10		
UNABLE	0		
STAIRS			
Normal up and down	50		
Normal up, down with rail	40		
Up and down with rail	30		
Up with rail unable down	15		
Unable	0		
SUB TOTAL			

DEDUCTIONS(minus)		**PRE-OP**	**POST OP**
WALKING AIDS	SCORE		
Cane	5		
Two canes	10		
Crutches or Walker	20		
TOTAL DEDUCTIONS			
FUNCTIONAL SCORE			

PATIENT CONSENT FORM

Study Title: **FUNCTIONAL OUTCOME AND ROTATIONAL ALIGNMENT OF FEMORAL COMPONENT IN UNNAVIGATED TOTAL KNEE ARTHROPLASTY.**

Study Centre: Department Of Orthopaedics, GMKMCH Salem

Participant Name: Age: Sex: I.P. No:

I confirm that I have understood the purpose of surgical procedure for the above study. I have the opportunity to ask the question and all my questions and doubts have been answered to my satisfaction.

I have been explained about the possible complications that may occur during surgical and post-surgical procedure. I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving any reason.

I understand that investigator, regulatory authorities and the ethics committee will not need my permission to look at my health records both in respect to the current study and any further research that may be conducted in relation to it, even if I withdraw from the study. I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from the study.

I hereby consent to participate in this study for various surgical procedures and their outcomes.

Time:

Date: Signature / thumb impression of patient

Place: Patient's Name:

S.No	Name	Age	Sex	IP No	Side	Indication	Knee Society Score				Type of prosthesis	Rotational alignment of Femoral component in external rotation (degrees)	Complication	Results	
							Pre Op		Post Op					KCS	KFS
							KCS	KFS	KCS	KFS					
1	Rajeswari	57	F	17636	R	RA	28	30	98	90	CS	6.1	-	(E)	(E)
2	vasantha	60	F	21251	L	RA	36	45	92	90	CR	5.4	-	(E)	(E)
3	Mohamed	67	M	21276	L	OA	22	45	90	90	CS	9.4	Femoral notching	(E)	(E)
4	Nagarajan	65	M	23712	R	RA	31	30	80	80	CR	7.4	Superficial infection	(G)	(G)
5	Rajenderan	65	M	24742	L	OA	29	45	98	90	CR	8.1	-	(E)	(E)
6	Puphavalli	65	F	81745	L	RA	36	30	97	90	CR	4.8	-	(E)	(E)
7	Bakiyalakshmi	55	F	39864	R	OA	34	50	90	90	CS	4.8	-	(E)	(E)
8	Rajammal	50	F	40478	R	OA	32	45	92	80	CR	7.2	-	(G)	(G)
9	Ramamoorthy	58	M	42217	L	OA	26	45	97	90	CR	4.6	Superficial infection	(E)	(E)
10	Murugan	62	M	49216	L	OA	14	20	80	70	CR	5.2	-	(G)	(F)
11	Parvathy	60	F	2486	L	OA	17	30	80	80	CR	6.8	-	(G)	(G)
12	Chitra	65	F	18235	R	OA	28	50	97	90	CS	4.6	-	(E)	(E)
13	Gunasekar	42	M	11258	R	Post traumatic	26	20	99	90	CR	8.4	-	(E)	(E)
14	Manikam	45	M	13772	L	OA	17	45	92	90	CR	7.8	-	(E)	(E)
15	Perumal	55	M	18382	R	OA	38	50	90	80	CR	4.3	-	(E)	(G)
16	Govindhasamy	50	M	49457	R	OA	28	50	98	90	CR	4.6	-	(E)	(E)
17	Dhanraj	68	M	24167	L	OA	26	45	92	80	CR	5	-	(E)	(G)
18	Ramasamy	40	M	26618	L	OA	37	30	98	90	CR	6.4	-	(E)	(E)
19	Sengodi	60	F	33322	L	OA	14	20	75	80	CR	10.4	-	(F)	(G)
20	Manic basha	54	M	41404	L	OA	24	20	97	90	CR	11	-	(E)	(E)

M- Male, **F**-Female, **R**-Right, **L**-Left, **OA**- Osteoarthritis, **RA**-Rheumatoid arthritis, **CR**- Cruciate retaining, **CS**- Cruciate substituting, **KCS**- Knee Clinical Score, **KFS**-Knee Functional Score, **E**- Excellent, **G**-Good, **F**-Fair